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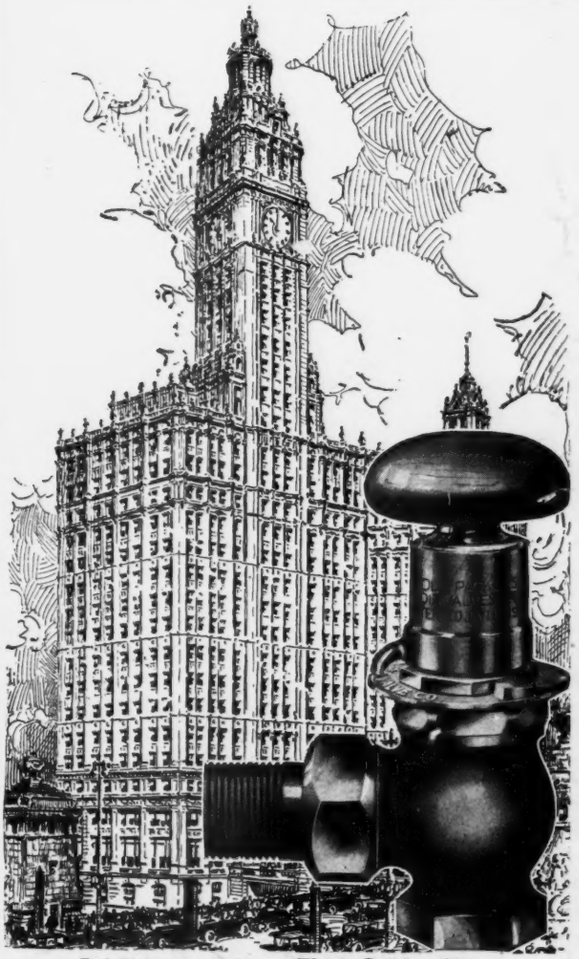

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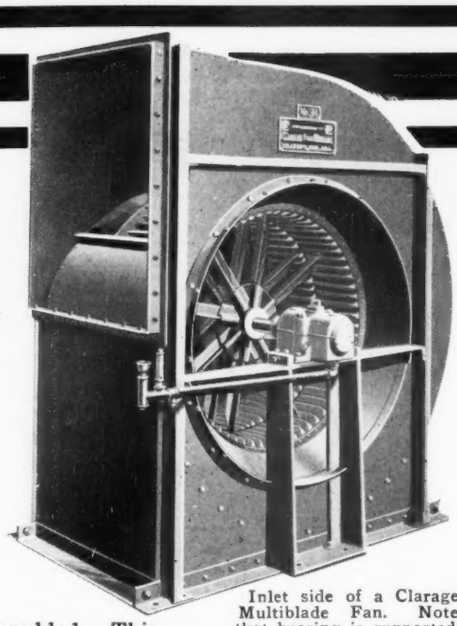

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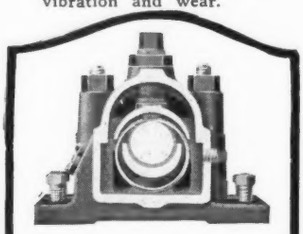
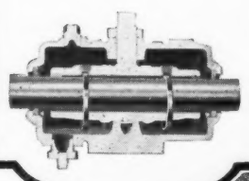
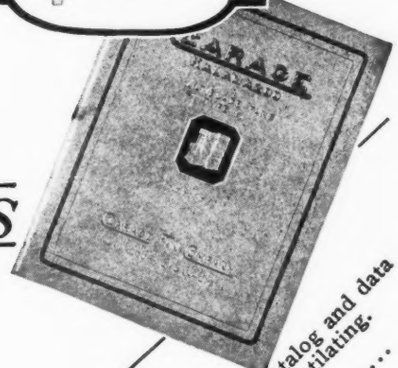




Above; Section through oil ring of Clarage Bearing. Note adjusting set screws in base of housing.

Below; Longitudinal view illustrating replaceable, self-aligning sleeve and felt washers.



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The Heating and Ventilating Magazine

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JANUARY, 1924

A Short, Practical Method of Designing Gravity Water Heating Systems

With Six Illustrative Problems Frequently Encountered in Practice, and Their Solutions

By F. E. Giesecke

Professor of Architectural Engineering, University of Texas

OF THE various systems of heating available at the present time, steam, water, and air heating are in most general use. The three systems differ considerably from each other; each has its distinctive advantages and disadvantages and, consequently, its peculiar field of service.

The principal disadvantage of water heating, particularly of gravity water heating, is the difficulty of designing and constructing the systems so that every radiator will receive its proper supply of heat. The reason for this difficulty is that the forces which produce circulation are so small that they are seriously affected by even a small variation in the friction in one or more of the pipe lines. A few additional elbows, a small increase in the horizontal distance from the distributing mains, a small increase in the elevation above the heater, or a small volume of air trapped in one of the pipe lines by virtue of inferior installation, may be sufficient to interfere very seriously with the flow of water to the radiator or to the group of radiators affected thereby. The result is that a person, who has designed or installed a water heating system in which the distribution of heat among the several radiators is not uniform and satisfactory, becomes very much discouraged and at the next occasion abandons hot water in favor of steam, simply because he feels that he can always deliver steam to every radiator. This, no doubt, explains why water heating is used less frequently than its merits justify.

To alleviate this condition as much as possible is the object of this treatise, which consists essentially of a series of graded examples, devised so as to explain a simple and accurate method of designing water heating systems in which the heat will be delivered to the several radiators according to a predetermined plan.

For the benefit of those who have not had the advantages of a college course in heating and ventilation, or its equivalent, a number of fundamental definitions and explanations have been added where they may be helpful.

In the series of articles of which this is the first, Professor Giesecke has begun a work which, when completed, will cover the entire field of water heating in the light of the latest advances in that branch. The initial series will deal with gravity hot water systems, together with a number of problems involving the cooling of water. A subsequent series will take up forced circulation of hot water, and central station heating systems. Professor Giesecke's reputation in the field of engineering research qualifies him to a degree to discuss the merits of water heating which, in the opinion of many, are not as much appreciated by American heating engineers as they should be. His articles may be expected to take rank among the important works on this subject, with the added feature of being based upon the most recent data obtained from his extensive experimental work in connection with water flow in pipes.

MEASUREMENT OF TEMPERATURE

In problems relating to heating and ventilation, the intensity of heat is generally measured by means of mercurial thermometers. For this purpose American and English engineers usually employ the Fahrenheit scale; other European engineers use the Centigrade scale. The two scales are related to each other so that the temperatures of water at the freezing and boiling points, under standard conditions, are respectively, 32° and 212° on the Fahrenheit and 0° and 100° on the Centigrade scale. If F and C represent, respectively, corresponding temperatures on the two scales,

$$F = 1.8\ C + 32 \text{ and}$$

$$C = (F - 32) \div 1.8$$

In this treatise the Fahrenheit scale is used except where otherwise stated.

THE UNIT OF HEAT

The quantity of heat required to raise the temperature of one pound of water from 63° to 64° is the British thermal unit, (B.T.U.).

The reason for specifying a definite temperature, 63° to 64° in defining a B.T.U., is that the heat necessary to raise the temperature of 1lb. of water one degree varies slightly with the temperature; the maximum

variation from the mean value for the range of temperature from 32° to 212° is less than 1%; the lowest value occurs at about 100° and the highest at 32°; the mean value is practically 1 B.T.U. Since these variations are so small they may be neglected in calculations relating to heating and ventilation. In this treatise a B.T.U. will be regarded as the quantity of heat required to raise the temperature of 1lb. of water one degree.

The quantity of heat dissipated in one hour by 1 sq. ft. of radiation is frequently used as the basis for the determination of pipe sizes for heating systems; i.e., the pipe size is selected in proportion to the number of square feet of radiation it serves. This is sometimes permissible in calculations relating to steam heating but hardly ever in those relating to water heating, because the quantity of heat dissipated by 1 sq. ft. of radiation is too indefinite; for example, a pipe coil, surrounded by 60° air, through which 190° water is flowing may dissipate about 300 B.T.U. per hour, per square foot, whereas a 3-col., 38-in. radiator, surrounded by 70° air and through which 160° water is flowing may dissipate only about 100 B.T.U., or about one-third as much. Calculations relating to the design of water heating systems should always be based on a definite quantity of heat.

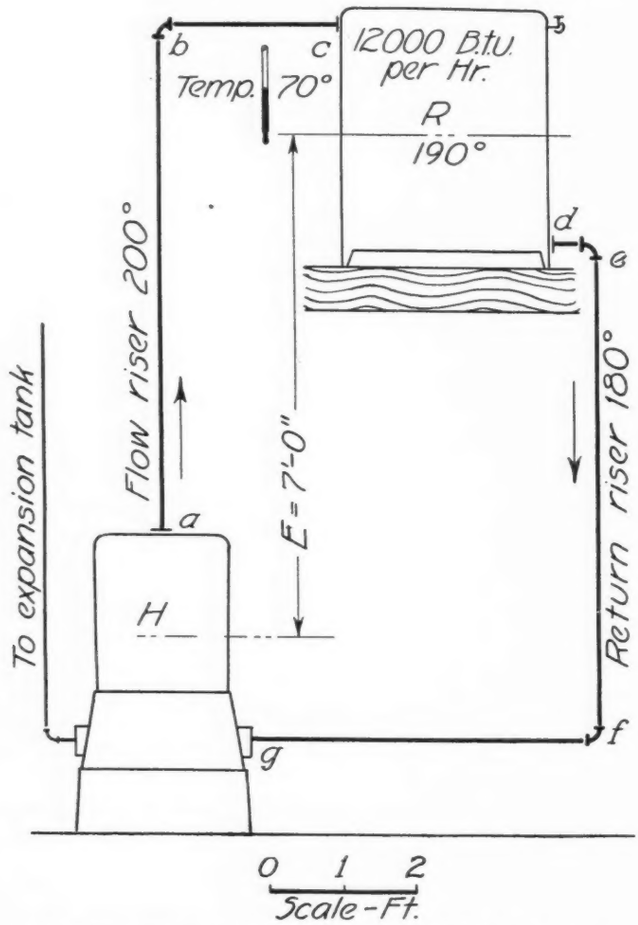


Fig. 1—System I, An Elementary Heating System.

HEAT TRANSMISSION OF RADIATORS

When a radiator is surrounded by air at a lower temperature than that of the heating medium within the radiator, heat will radiate from its surface and, in addition, air currents will be formed which pass along its surface, become heated by contact with the same, and carry off heat. The number of heat units dissipated by a radiator in one hour, for 1 sq. ft. of radiating surface, and for 1° of temperature difference of the heating medium within the radiator and the surrounding air is the unit of heat dissipation or heat transmission of the radiator; it is generally represented by the letter K.

The value of K depends upon the temperature of the radiating surface; upon the temperature difference of that surface and the surrounding air; upon the size, shape, and character of the radiating surface; and upon the motion of the surrounding air.

Heat dissipation of steam radiators has been carefully studied and is fairly well understood; for hot-water radiation additional research is highly desirable. Table I shows average values of K for hot-water radiation.

QUANTITY OF HEAT REQUIRED

It is assumed that the reader understands the method of calculating heat losses and is able to determine the heat required for the respective rooms or spaces in which the several radiators are to be placed. For convenient reference, a brief review of the method will be found in Appendix A of this treatise, which will appear later.

GRAVITY CIRCULATION OF WATER

In System I, the elementary heating system shown in Fig. 1, the water circulates in the direction shown by the arrows. During this circulation, while the system is in operation, the water is heated as it flows through the heater and cooled as it flows through the radiator.

During the "heating-up" period, when the water absorbs more heat while flowing through the heater than it loses while flowing through the radiator, in a given interval of time, the water circulates with an accelerated velocity; during the period of "steady-operation," when the rate of heat absorption in the heater is the same as the rate of heat dissipation by the radiator, the water circulates with a uniform velocity; during the "cooling-down" period, when the rate of heat absorption is less than the rate of heat dissipation, the water circulates with a retarded velocity. When the temperature of the water is uniform throughout the heating system, there is no gravity-circulation.

In this discussion the dissipation of heat by the pipe lines has been neglected; its effect will be considered later.

Water heating systems are designed for conditions obtaining during the period of steady operation; i.e., when the water is circulating with a uniform velocity.

In every case of gravity circulation the force producing the flow of the water is the difference between the weight of the cooler, and therefore heavier, water in the return riser and that of the hotter, and therefore lighter, water in the flow riser. To understand this clearly, note that the pressure due to the flow riser tends to cause the water in the horizontal pipe g f to flow from g toward f, while the pressure due to the water in the return riser tends to cause the water to flow in the opposite direction. Since the latter pressure is the greater of the two, the water in g f will be forced to flow from f toward g by the difference between the two pressures. If the water in the section g f flows from f toward g the circulation in the system is in the direction shown by the arrows.

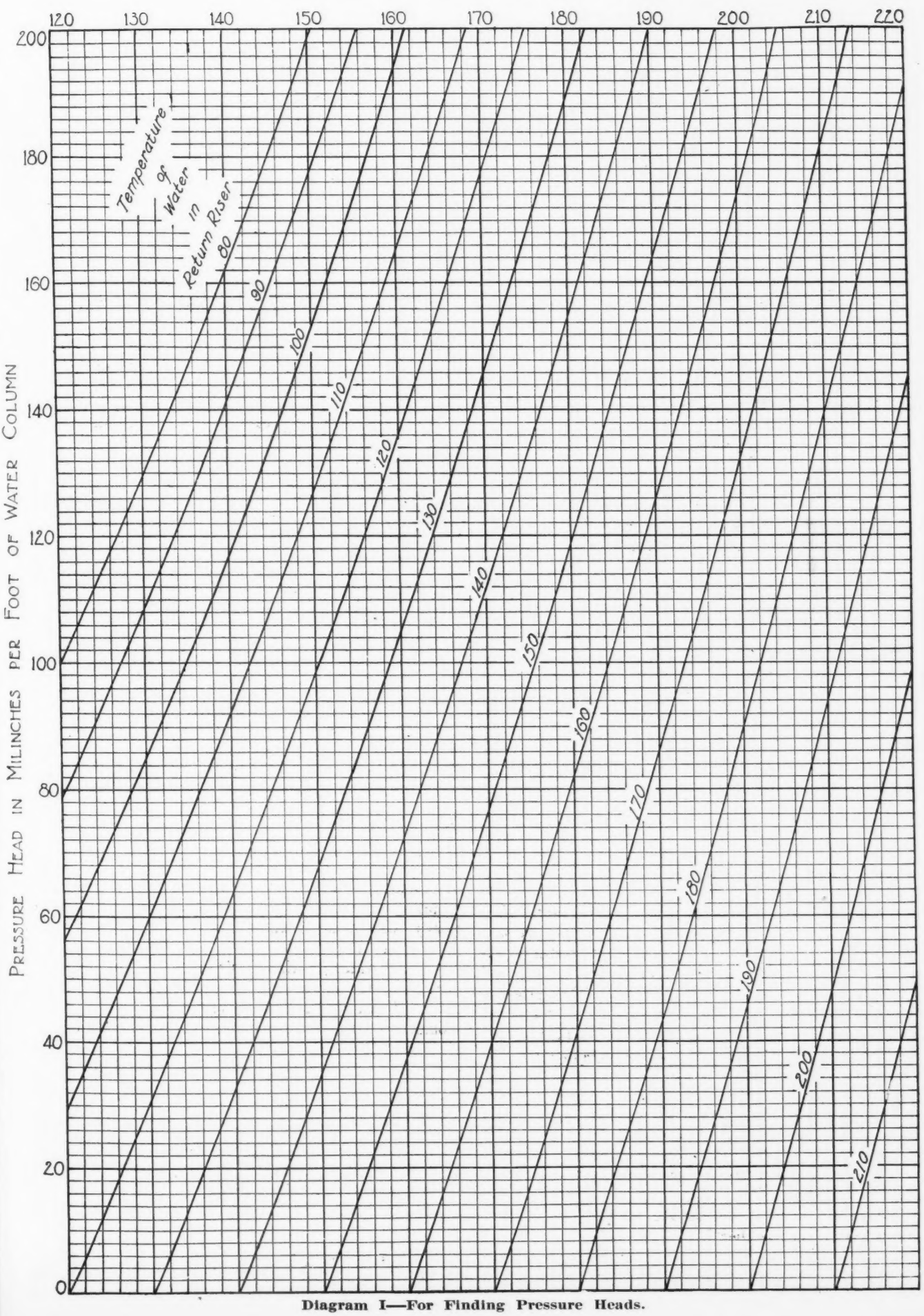


Diagram I—For Finding Pressure Heads.

The force which causes the water in the section g f to flow from f toward g acts continuously and therefore tends to produce a continuously increasing velocity; however, as the velocity of the water increases, the frictional resistances in the pipes, fittings, valves, radiators, and heater increase until the friction is so great that no further increase in the velocity is possible and the period of steady flow begins. During this period the frictional resistances of the system are exactly equal to the force maintaining flow and this is the condition for which water heating systems should be designed.

The design of a gravity water heating system then resolves itself into the very simple problem of adjusting the system so that for every radiator the pressure-head, that is the force maintaining flow to and from the radiator, is equal to the friction-head for that radiator circuit when the water is flowing with such a velocity that the radiator is receiving its assigned quantity of heat. While this statement of the problem is a very simple one, the actual solution is not so simple and will be explained in detail.

PRESSURE-HEAD

Let it be required, for System I, that the temperature of the water in the flow and return risers be, respectively 200° and 180°. As the water flows through the radiator its temperature changes gradually from 200° to 180°; similarly, as it flows through the heater its temperature changes gradually from 180° to 200°. We may assume, therefore, that the difference in the pressures due to the weight of the water in the flow and return risers is the same it would be if the height of the two risers were equal to the elevation of the center of the radiator above the center of the heater; that height is the one selected for calculating pressure-heads for radiators connected like the one in System I. If both risers were connected to the bottom of the radiator, the height of the column of water producing the pressure-head would be approximately equal to the elevation of the bottom of the radiator above the center of the heater.

To find the pressure-head for System I, note from Table I that the weights of water at 200°, 190° and 180° are, respectively, 60.12, 60.36, and 60.58 lbs. per cubic foot; the pressures per square foot due to the weight of the water in the flow and return risers (7 ft., 0 in. high) are then, respectively, 420.8 and 424.1 and their difference is 3.3 lbs. per square foot. This is the pressure which produces circulation in System I; it should be expressed not in pounds per square foot but in the height of a column of water whose weight produces that pressure and whose temperature is the mean of those of the water in the two risers; or 190° in System I. The required pressure-head is therefore 3.3×60.36 or about 0.055 ft., or 0.66 in. of water.

To reduce the labor of finding pressure-heads, Diagram I was constructed. To learn its use, find 200 in the upper marginal line of the diagram and traverse the diagram vertically to the point of intersection with the 180° line; from this point traverse the diagram horizontally to the left margin and read 90 milinches per foot of pipe. (A milinch, m.i., is one-thousandth of one inch). The total pressure-head is therefore 7×90 or 630 m.i. This value, obtained from the diagram, is checked approximately by the calculated value. Hereafter pressure-head determinations will be made with the aid of the diagram since this method is simple and easy and the results are sufficiently accurate.

VELOCITY OF WATER

In System I the radiator is to dissipate 12000 B.T.U. per hour and the temperature-drop through the radiator is to be 20°; the water must therefore flow through the radiator at the rate of $12000 \div 20$, or 600 lbs. per hour; it must flow into the radiator at the temperature of 200° and at the rate of $600 \div 60.12$, or 9.98 cu. ft. per hour, and out at the temperature of 180° and at the rate of $600 \div 60.58$, or 9.90 cu. ft. per hour. The fact that a larger volume of water flows into the radiator than flows out is due to the contraction of the water in the radiator during the period of cooling. If the same size pipe is used for the flow and return risers the velocity of the water in the flow riser is higher than that in the return riser; if very great accuracy were required it would be necessary to make separate velocity calculations for the two risers. This is not necessary because it is sufficiently accurate to calculate the mean velocity, or the velocity corresponding to the mean temperature of the water in the radiator.

In System I the mean temperature is 190° and the corresponding rate of flow is $600 \div 60.36$, or 9.94 cu. ft. per hour. Reference to Table II shows that for ¾-in., 1-in. and 1¼-in. pipe, the lengths of pipe necessary to contain one cubic foot are, respectively, 270, 166.9, and 96.25 ft.; hence, if ¾-in. pipe is used for the risers of System I, the mean velocity will be $(9.94 \div 3600) \times 270 \times 12$ or 8.9 in. per second. Similarly, for 1-in. and 1¼-in. pipe the corresponding mean velocities will be, respectively, 5.5 and 3.2 in. per second.

THE FRICTION-HEAD

The frictional resistances to the flow of water through pipes depend upon the velocity and temperature of the water, upon the length and diameter of the pipe, and upon the character of the inner surface of the pipe. The frictional resistances to the flow of water through fittings and valves depend not only upon the five factors named above, but also upon the shape or form of the fittings and valves. The frictional resistances of straight pipe, of 90° elbows, of a number of other fittings, and of several types of valves have been determined experimentally and are known quite accurately. It is practically impossible to know the frictional resistances of every type of fitting and valve and, for the purpose of designing water heating systems, it is sufficiently accurate to express these resistances in terms of the resistance of one 90° elbow, according to the following tabulation:

1 90° ellbow	1.0
1 45° elbow	0.9
1 Open return bend	1.0
1 Tee	2.2
1 Open gate valve	0.5
1 Open globe valve	12.0
1 Angle radiator valve	2.0
1 Radiator	3.0
1 Heater	3.0

These relations are very nearly correct for the low velocities in gravity circulation; for the higher velocities in forced circulation, they are sufficiently accurate because every radiator has practically the same number

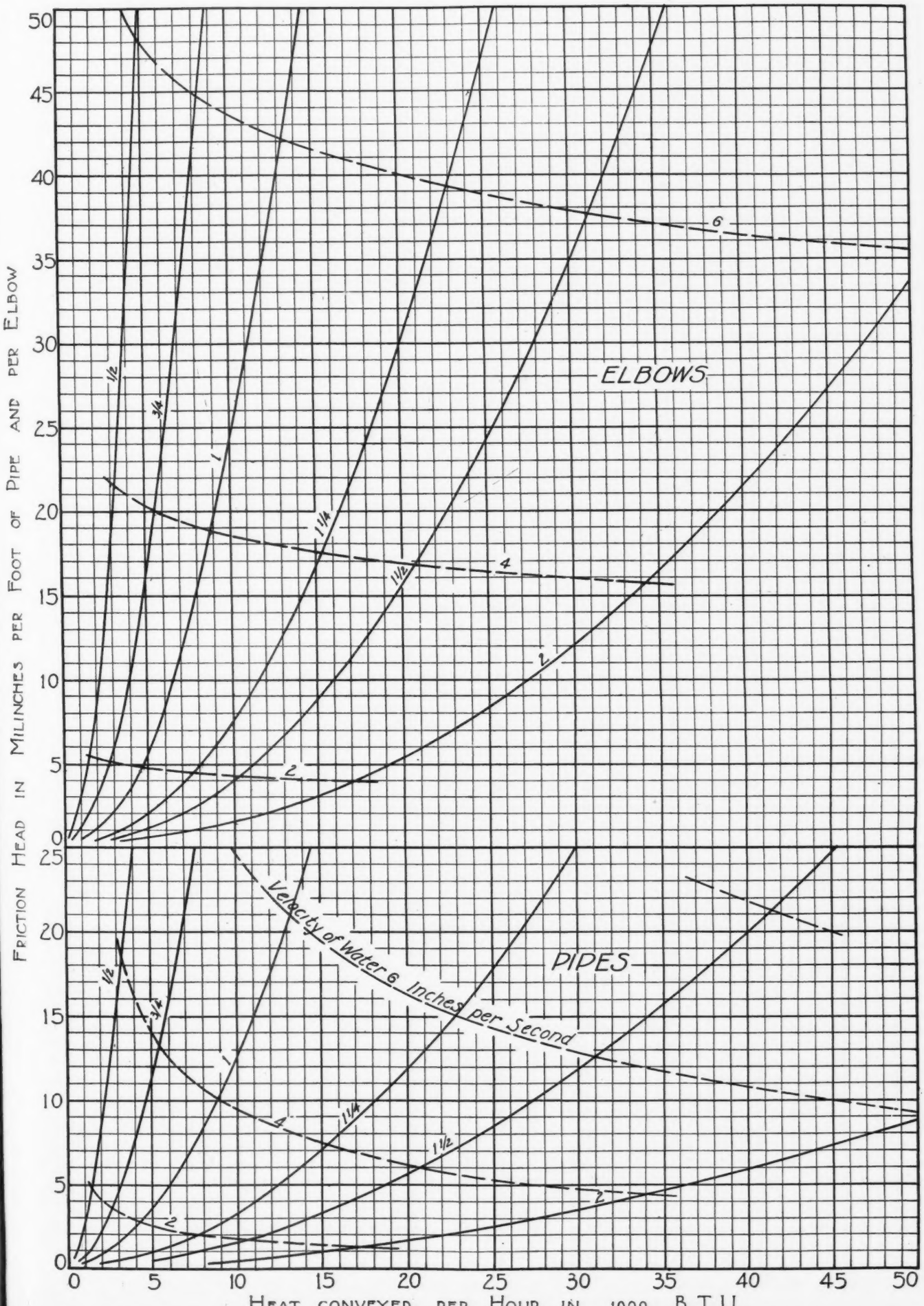


Diagram II—For Finding Friction Heads in Pipes and Elbows.

of valves and tees in its circuit and is, therefore, affected equally by any variation from the ratios given above.

If all the frictional resistances in a heating system, other than those due to straight pipe, are expressed in terms of the frictional resistance due to one elbow, as suggested above, the entire friction-head in any heating system can be expressed in terms of the friction-heads due to a definite number of feet of pipe and a definite number of elbows. The calculation of the friction-head due to one foot of pipe or due to one elbow is not very simple, and the method is, therefore, fully explained in Appendix B, to appear in a later issue.

For actual use in designing heating systems, Diagrams II, III, IV, and V were prepared. The required friction-heads may be found with the aid of these diagrams as follows:

To find the friction-head due to 1 ft. of 1-in. pipe for System 1 when heat is being delivered to the radiator at the rate of 12000 B.T.U. per hour with a temperature-drop through the radiator of 20°, select Diagram II; find 12000 on the lower marginal line; traverse the diagram vertically to the intersection with the lower 1-in. line; from this point traverse horizontally to the left margin and find 18 m.i. per foot of pipe.

To find the friction-head due to one elbow, proceed as above, using the upper instead of the lower 1-in. line and find 35 m.i. as the required friction-head. In both cases note that the corresponding velocity shown in the diagram is about 5.5 in. per second, which agrees with the value calculated above for 1-in. pipe. If 1¼-in. pipe were used for the risers, the corresponding friction-heads would be 5 m.i. per foot of pipe and 11 m.i. per elbow, and the velocity about 3 in. per second.

DESIGN OF SYSTEM I

Let it be required to design the pipe lines and the radiator for the conditions shown in the illustration.

For steady operation the pressure-head for the radiator must be equal to the corresponding friction-head. The pressure-head is found by means of Diagram I, as explained above, to be 7×90 or 630 m.i. The friction-head for the radiator circuit is due to the frictional resistances in the heater, the flow line, the radiator, and the return line, or to 1 heater, 1 radiator, 22 ft. of pipe, and 3 elbows. According to the tabulation above, the frictional resistances in the heater and radiator are, together, approximately equal to those in 6 elbows; hence the total friction-head in System I may be considered equal to that in 22 ft. of pipe and 9 elbows and should be 630 m.i., as nearly as practicable. The corresponding pipe sizes are found by trial in the following manner:

Assume a 1-in. pipe and find the friction-head by means of Diagram II, as explained above, to be 18 m.i. per foot of pipe and 35 m.i. per elbow; the total friction-head is, therefore,

$$\begin{aligned} 22 \times 18 &= 396 \\ 9 \times 35 &= 315 \quad 711 \text{ m.i.,} \end{aligned}$$

or 81 m.i. more than the available pressure-head. This shows that a 1-in. pipe is not quite large enough.

Assume a 1¼-in. pipe; proceed as above and find the friction-head to be

$$\begin{aligned} 22 \times 5 &= 110 \\ 9 \times 11 &= 99 \quad 209 \text{ m.i.} \end{aligned}$$

or 421 m.i. less than the available pressure-head. A 1¼-in. pipe is, consequently, much too large and the correct size is nearer to 1 in. than to 1¼ in.; in other words, if the line were composed of 1-in. and 1¼-in. pipe considerably more than one-half of the total length should be of 1-in. pipe.

In actual practice the installation would generally be made with 1-in. pipe because a difference of 81 m.i. is too small to cause appreciable variation from the desired performance.

If it is desired to design the pipe line so that the friction-head for the system will be practically 630 m.i. the following method should be employed. Note from the above calculation, or from Diagram II, that the friction-heads due to 1 ft. of 1¼-in. pipe and to one 1¼-in. elbow are less, respectively, than those due to 1 ft. of 1-in. pipe and to one 1-in. elbow by 13 and 24 m.i.;

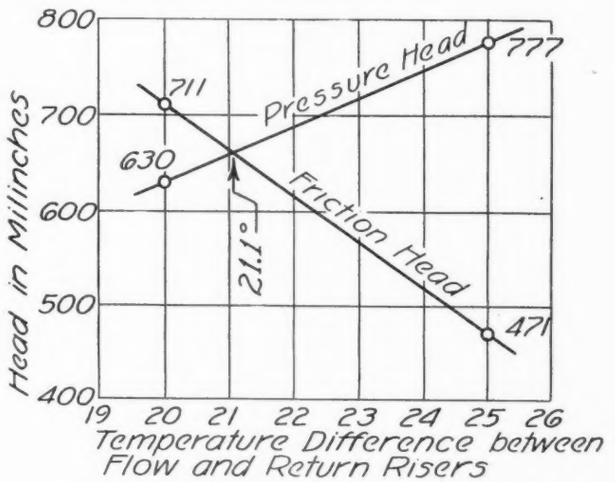


Fig. 2—Graphical Method of Finding Temperature Drop Through the Radiator.

hence for every foot of 1-in pipe which is replaced by 1¼-in. pipe the friction-head is reduced 13 m.i., and for every 1-in. elbow which is replaced by a 1¼-in. elbow the friction-head is reduced 24 m.i. The friction-head in the 1-in. pipe line can therefore be easily reduced from 711 to 630 m.i. by replacing a portion of the 1-in. line by a 1¼-in line.

The substitution may be made anywhere in the circuit; it is customary to make it next to the heater. In that case one-half of the frictional resistance due to the heater should be assigned to the 1¼-in. line; the combination pipe line could then be made up as follows: 4 ft. of 1¼-in. pipe with 1½ elbows (one-half of the heater equivalent) and 18 ft. of 1-in. pipe with 7½ elbows. The corresponding friction-head would be

$$\begin{aligned} 4 \times 5 &= 20 \\ 1\tfrac{1}{2} \times 11 &= 17 \\ 18 \times 18 &= 324 \\ 7\tfrac{1}{2} \times 35 &= 263 \quad 624 \text{ m.i.} \end{aligned}$$

If the installation is made entirely with 1-in. pipe it is interesting to know with what temperature difference circulation will take place during the period of steady operation. This can be determined in the following manner: For a 20° temperature difference the pressure-head and friction-head are, respectively, 630 and 711 m.i.; for a 25° temperature difference the available pressure-head is (from Diagram I for 200° and 175°) 7 × 111 or 777 m.i.

The friction-head is 471 m.i. determined as follows: If the temperature-drop through the radiator is increased

from 20° to 25°, the quantity of water which must flow through the radiator and the velocity of the water in the pipe lines are both reduced in the proportion of 25 to 20; consequently the friction-head in the system is the same as it would be for a 20° temperature difference if the quantity of heat conveyed were reduced in the proportion of 25 to 20. Diagram II can therefore be used and the unit friction-heads corresponding to 20/25 of 12000, or 9600 B.T.U., found to be 12 m.i. per foot of pipe and 23 m.i. per elbow; the total friction-head will then be

$$22 \times 12 = 264$$
$$9 \times 23 = 207 \quad 471 \text{ m.i.}$$

It is evident from these calculations that the required temperature difference is more than 20° and less than 25°. Assuming that the pressure-head and the friction-head vary uniformly between these temperatures, the required temperature difference, 21.1°, may be found graphically as shown in Fig. 2.

The determined temperature difference being so nearly 20° shows that in almost all cases it is unnecessary to insert the short section of 1¼-in. pipe discussed above.

Actual tests of the accuracy of such calculations as those just described and those which follow are interesting and profitable; the observed temperatures should agree closely with those calculated.

(*To be continued.*)

New Data on the Weather in the United States

By G. J. O'Connor

(See Pp. 84–87 for new weather data tables.)

THE accompanying data have been compiled in response to a request for figures which would give not only the highest and lowest temperatures to be expected in the United States, but, also, the mean average temperature for the year, the mean average temperature for the heating season, and the length of the heating period. A temperature approximating 60° F. is assumed as that lower than which it becomes uncomfortable to sit indoors, due consideration being had of the relative amount of moisture in the air.

The information has been obtained by diligent search of the records of the United States Weather Bureau up to December 1, 1923. Tables of somewhat similar data have been published from time to time, but such tables, of course, are subject to revision because of changes in extremes of temperatures especially. These changes, it may be added, do not appear to indicate any gradual trend towards a warmer climate in any section of the country.

An average temperature has been determined not only for the year as a whole, but for those months in which the intensity of cold increases from October 1 to mid-winter and thence moderates again to the warmer weather that comes with the lengthening days of sunlight in Spring.

At stations along the Gulf coast heating is necessary only in December, January and February. Here the approximate heating season does not exceed 90 days, or about 2160 hours. In States bordering on the Canadian line and in parts of New England, these conditions are reversed. In these parts we find some stations where the monthly mean temperature averages below 60° F. for more than nine months of the year, leaving less than 2,000 hours when human nature can well endure the chilly atmosphere without additional heat.

A killing frost is one that is described as destructive of all tender vegetation and hurtful to hardier plants. It usually occurs at the surface, before the instruments at the local office of the Weather Bureau, atop some lofty building, record a temperature of 32°. At New York, for instance, the earliest date of a killing frost in Autumn is October 15; the average date is November 6. In Spring the latest date of a killing frost is April 30; the average date is April 10.

Comfort ordinarily requires manufactured heat in dwellings after the middle of October in cities like New York. The Sanitary Code of New York City (Sec. 225, Art. 12) stipulates 68° F. as the minimum temperature in every occupied room or place of residence where the landlord, or other contractor, agrees by lease or contract to provide heat for the tenant. "The term 'at all such times,' as used in this section, unless otherwise provided by a contract or agreement, shall include the time between the hours of 6 A.M. and 10 P.M. in a building, or portion thereof, occupied as a home or place of residence, and during the usual working hours (established and maintained in a building, or portion thereof, occupied as a business establishment) of each day whenever the outer or street temperature shall fall below 50° F."

The normal mean temperature of New York on November 1 is 50°. Thus it may be seen that the actual heating season begins about three weeks after the outside temperature passes below 60° in Autumn and ends a fortnight before the temperature rises above that mark in Spring.

Similar laws and circumstances exist in other large cities and like information may be obtained from the local office of the U. S. Weather Bureau. This is especially true of cities in the middle latitudes. In the northern border States hardier man withstands the cold without manufactured warmth for a period differing by circumstances of location. In the Gulf States habitations are not commonly built like those in the North; there people are quite unprepared for a touch of zero weather which obtains in that section only rarely.

So, too, with the Pacific Coast region. Cold waves, as such, rarely occur, as also exceptionally high temperatures. "The Great Divide" separates the inhabitants of California from the continental cold waves from the north, while ocean currents mitigate the severity of the Siberian temperatures long before they reach American shores.

The result is a mild temperature averaging in the 50's at San Francisco from September to April, inclusive. In the early morning, from December to February, inclusive (the minimum temperature there averages well down in the 40's.

Commercial Efficiency of Single and Graded Steam Pipe Coverings

Results of Recent Tests on Magnesia, Air Cell, Asbestocel, Carocel, Nonpareil, Sponge Felt and Multiply Types

IN THE tests here described the testing machine itself was one of the principal features of interest. One of the primary requirements for testing pipe coverings is a constant and easily adjustable source of heat. The accompanying illustration (Fig. 1) shows how this requirement was met. The machine consists of a standard 5-in. steel pipe about 15½ ft. long, filled with oil. One end was closed with a steel plate welded to the pipe. The other end was fitted with a flange to which was bolted a plate carrying a stuffing gland on the outside.

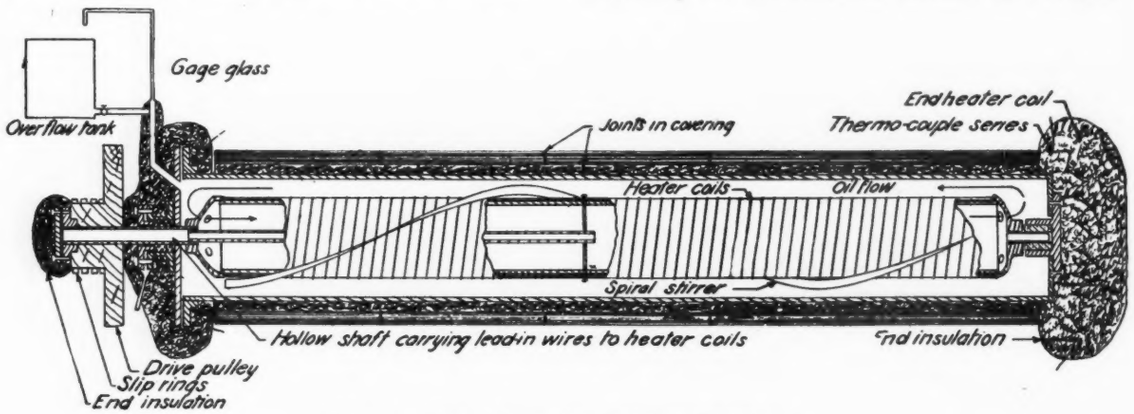


Fig. 1—Pipe Covering Testing Machine.

Carried on bearings inside the pipe was a 2-in. pipe on which was wound an insulated electric heating element. This element consisted of No. 16 iron stove-pipe wire wound non-inductively around the 2-in. pipe, asbestos paper being used for insulation.

Leads to three separate sections of the heater were brought from the slip rings shown, into the machine through the hollow shaft extending from the 2-in. heater pipe out through the stuffing gland mentioned above. A steel ribbon 3/32 in. x ⅜ in., wound into a spiral of 18-in. pitch, was attached to the heater pipe so that it stood ¼ in. above the heater element and cleared the inside of the 5-in. pipe by about ½ in.

This spiral acted as a screw to both rotate the oil and give it an endwise motion through the machine. The return path was provided through the 2-in heater pipe so that when the machine was in operation the rotating heater also thoroughly stirred the oil to maintain the temperature uniform throughout.

The heater-stirrer was rotated at 25 R. P. M. by means of a motor belted through a reduction gear to a pulley on the end of the hollow heater shaft. Slip rings adjacent to the pulley and connected to lead wires coming out between gaskets in the flanged union on the end of the hollow shaft, served to convey current to the heating element within. The current from the transformer was controlled by means of a lamp bank in series with the heater.

Oil was used as a heat conveying medium and since oil expands with a rise in temperature, provision was necessary for considerable increase in volume. An outlet was located in the end of the machine so that it would first lead off all the air and gas in the system and then as the temperature increased conduct the excess volume of oil into a reserve tank. This overflow was a glass tube ⅛ in. internal diameter. By adjusting the oil level properly, the entire machine became a huge thermometer with a bulb of about 12½ gal. capacity and a ⅛ in. glass stem in which 1° F. equaled about 18 in. length of stem.

Control of the electrical input to the heater coils made it possible to maintain a steady temperature in the system as indicated by the constant position of the oil level in the glass stem.

Heat was supplied to the machine through the three electric heating elements mentioned above. The electrical input was measured in watts by means of an indicating wattmeter and this was converted into heat equivalent by the constant, 3.415, which is B. T. U. per watt-hour. The heat put into the machine to hold the temperature constant represents the amount of heat that is being radiated out through the covering and if this input is divided by the surface area of the pipe, the

The tests here described of heat insulating materials were conducted at the State College of Washington, and were reported in Engineering Bulletin No. 12 by H. J. Dana, specialist in experimental engineering. Their primary object was to provide information leading to greater savings through the use of commercial steam pipe coverings. Routine tests were first made on samples of commercial coverings and the results were checked with those of other investigators for the purpose of establishing the accuracy of the methods used. Then the study was made of the thermal and economic efficiencies of graded combinations of commercial coverings.

The arguments for graded coverings apply more particularly to two conditions. First, a great many installations at present are using one thickness of good covering and do not consider it a good investment to apply another thickness of the same priced covering, not knowing that at the comparatively low temperature at which the outside layer of covering would work, the cheaper grades of covering are almost as efficient as the most expensive grades. Second, in some new installations it should be possible to apply the graded coverings with greater economic efficiency than is possible with an application of uniform covering.

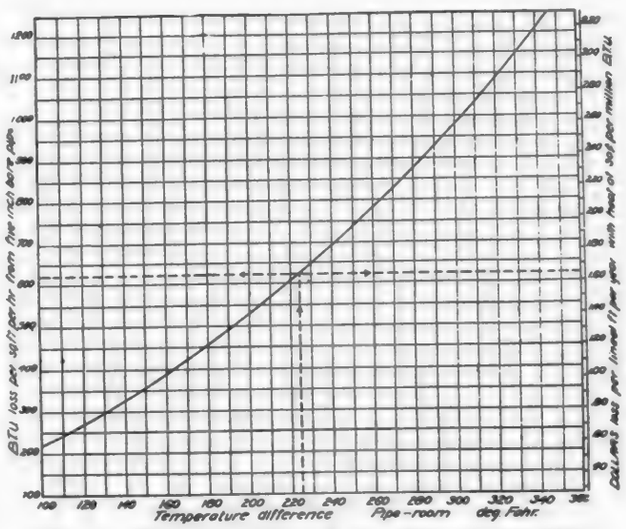


Fig. 2—Heat Loss from 5-In. Bare Steam Pipe.

was applied another coating of magnesia cement about 1 in. thick and to the surface of this was applied a pancake heating element, which in turn was covered with a final coating of plastic cement. When the current to this auxiliary heater was properly adjusted, the temperature at the heater element is the same as the temperature at the surface of the end of the pipe and there would be no transfer of heat, or end radiation from the machine itself. In other words, the end heater was supplying the end losses.

TESTS MADE

Tests were made on coverings bought in the open market and applied to the pipe according to common practice in engineering work. Magnesia, air cell, "asbestocel," "carocel," "nonpareil," "sponge felt," and "multiply" were among the coverings investigated. Each new set of covering after being applied to the testing machine, was brought up to the highest testing temperature and dried

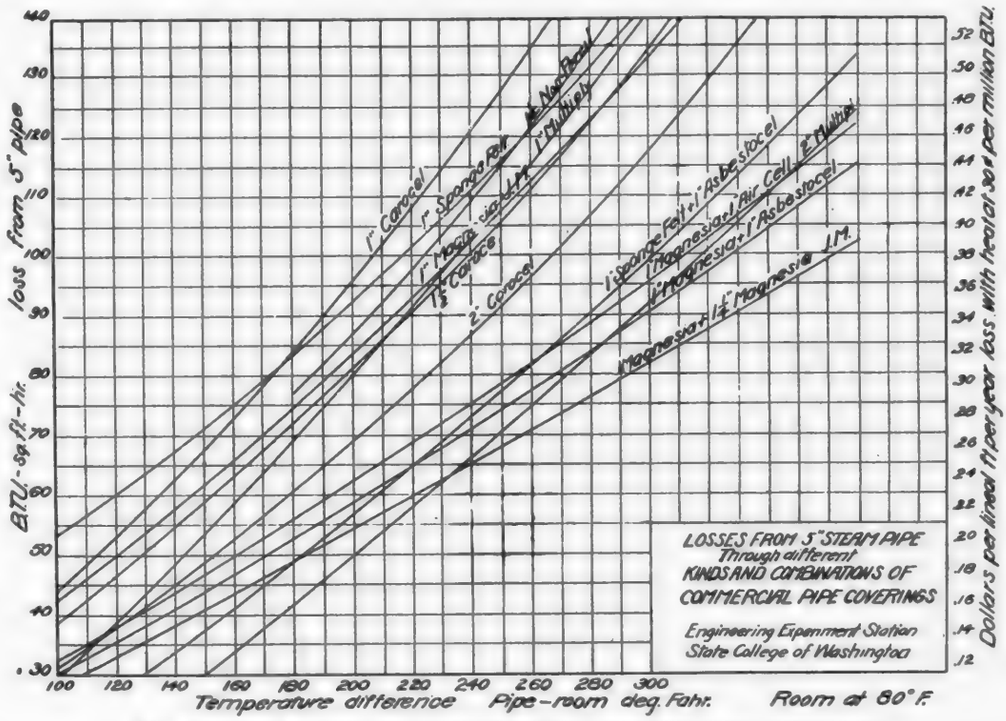

BTU - Sq. ft. - hr. loss from 5" pipe
Dollars per lineal ft. per year loss with heat at 30¢ per million BTU
1" Carocel
1" Sponge felt
1" Magnesia
1" Multiply
1½" Carocel
2" Carocel
1" Sponge felt + 1" Asbestocel
1" Magnesia + Air Cell + 2" Multiply
1" Magnesia + 1" Asbestocel
1" Magnesia + 1¼" Magnesia + 1" M.
LOSSES FROM 5" STEAM PIPE Through different KINDS AND COMBINATIONS OF COMMERCIAL PIPE COVERINGS
Engineering Experiment Station State College of Washington
Temperature difference Pipe-room deg. Fahr. Room at 80° F.

Fig. 3—Heat Losses Through Samples of Steam Pipe Coverings.

average radiation per square foot is the result.

However, due to the shape and irregularities of the ends of the pipe, it is almost impossible either to measure the area accurately or put on a covering which will give the same radiation per square foot as the straight part of the pipe. Since it was so uncertain and difficult to determine the end losses accurately, it was decided to eliminate them entirely from the calculations.

METHOD OF CONTROLLING END HEAT LOSSES

To control end losses a coating of plastic magnesia cement was applied to the end portions of the machine so that the intervening length of 5-in. pipe would accommodate 14½ ft. of standard sectional covering. About a dozen ¼-in. holes were drilled perpendicularly into each end coating of cement and in these were inserted alternate junctions of a number of thermo-couples connected in series. The remaining and opposite junctions were left against the outside surface of the cement. Over this

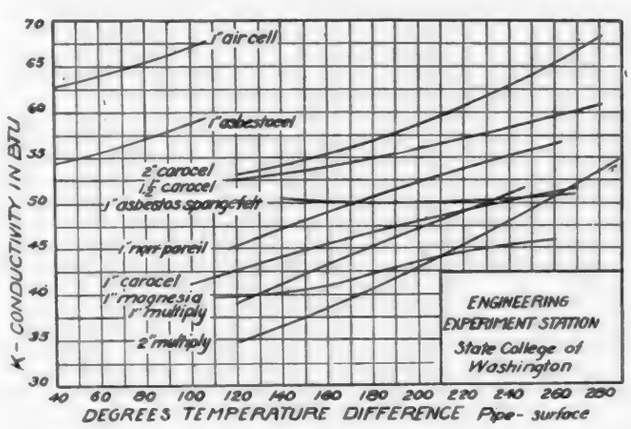


Fig. 4—Values of Conductivity "K" for Sample Coverings.

several days before any data were taken, then losses were measured at successively decreasing temperatures. Previous to and during a test the room temperature was maintained constant, and as free from air currents as possible. taken, then losses were measured at successively decreasing temperatures. Previous to and during a test the room temperature was maintained constant, and as free from air currents as possible.

pipe. In addition, it also shows the annual cost of single thickness coverings large enough to go over the coverings already in place. This annual cost is computed on the basis of the list price, at the discounts up to 60% off, plus 10% of list price for erecting; assuming 6% interest on total first cost, and 5% of total first cost for upkeep, etc. The basis for computing the sinking fund annuity is 6%.

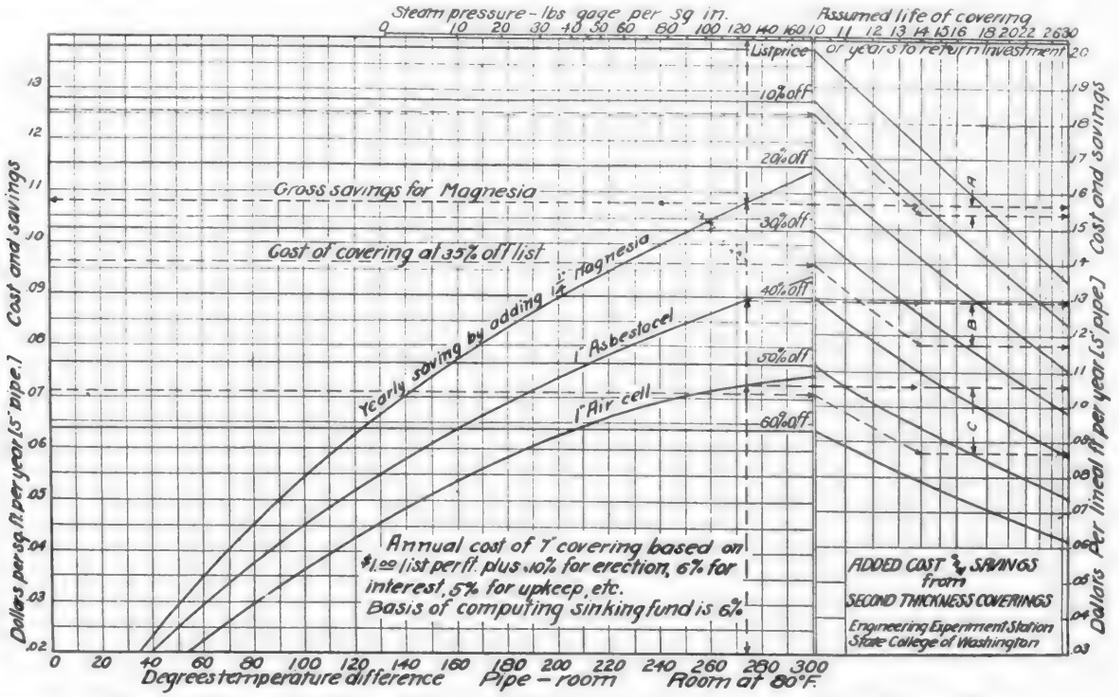

Steam pressure - lbs gage per sq in.
Assumed life of covering or years to return investment
List price
10% off
20% off
30% off
40% off
50% off
60% off
Gross savings for Magnesia
Cost of covering at 35% off list
Yearly saving by adding 1¼" Magnesia
1" Asbestocel
1" Air cell
Annual cost of 1" covering based on $1.00 list per ft. plus 10% for erection, 6% for interest, 5% for upkeep, etc.
Basis of computing sinking fund is 6%
ADDED COST & SAVINGS from SECOND THICKNESS COVERINGS
Engineering Experiment Station State College of Washington
Dollars per sq. ft. per year (5" pipe) Cost and savings
Dollars per lineal ft per year (5" pipe) Cost and savings
Degrees temperature difference Pipe – room Room at 80° F.

Fig. 5—Economic Value of Second Thickness of Covering on 5-in. Steam Pipe.

To eliminate the necessity for the use of involved calculations for those not interested in the mathematical solution for heat loss through graded pipe coverings, the chart shown in Fig. 3 has been prepared to give the results for 5-in. pipe. Fig. 4 gives comparative values of heat loss for different kinds and combinations of coverings.

A study of this chart discloses the fact that a graded combination of sponge felt and asbestocel is more efficient than magnesia and air cell at a temperature difference below 265° F., while above that temperature the reverse is true. A comparison between dollars loss per lineal foot per year for any covering and the loss per year for the same pipe bare (Fig. 2) will show the amount saved by the coverings selected.

Fig. 5 shows the savings in dollars per lineal foot per year due to adding either of three different coverings over a covering of 1-in. magnesia already in place on a 5-in.

As an illustration of the use of the chart, a given installation of 5-in. pipe is carrying 125 lbs. of steam and is covered with 1-in. magnesia. Room temperature is 80° F. Examples are given where the investment is to be returned in 14, 20 and 30 years. Market prices of covering are assumed to be as shown in the following table for one lineal foot of covering:

In the three cases cited the greatest total annual saving would accrue from using magnesia. However, aircell, the most inexpensive covering of the three types considered, will show the greatest per cent. return on the annual cost.

If the life of the covering, instead of a certain number of years, is made the basis of the yearly cost, the table will suggest some possible conclusions. For instance, assume the life of one covering as 14 years, another as 20 years, and the third as 30 years. These examples will show the use to which this chart (Fig. 5) can be put for

MARKET PRICES OF DIFFERENT COVERINGS PER LINEAL FOOT

Kind of Covering	Life Assumed	Price Assumed	Cost Per Year	Total Savings Per Lineal Ft. Per Year	Net Savings Per Year	Net Savings in Per Cent of Annual Cost
1¼" Magnesia	14 years	12% off	.154	156	.002	1.29%
1" Asbestocel	14 years	35% off	118	129	011	9.30%
1" Aircell	14 years	55% off	.086	.106	.020	23.30%
1¼" Magnesia	20 years	12% off	133	156	.023	1.71%
1" Asbestocel	20 years	35% off	102	129	.027	26.50%
1" Aircell	20 years	55% off	075	106	.031	41.30%
1¼" Magnesia	30 years	12% off	120	156	.036	3.00%
1" Asbestocel	30 years	35% off	092	129	037	40.20%
1" Aircell	30 years	55% off	068	106	.038	56.00%

determining what type of covering it is most profitable to apply under given conditions.

APPROXIMATE HEAT LOSS FROM COVERINGS ALREADY INSTALLED

Fig. 6 is a chart for determining the approximate radiation from a given installation of pipe covering already in operation, without the necessity of knowing the steam pipe temperature or kind of covering in use or its condition. The outside diameter of the covering is easily obtainable and the air temperature can be measured in the ordinary way with a mercury thermometer.

The surface temperature is measured by means of a thermometer bound to the side of the covering, with the bulb under a single thickness of 3-oz. canvas. Then the temperature difference between covering surface and air, applied to the chart for the outside diameter of the

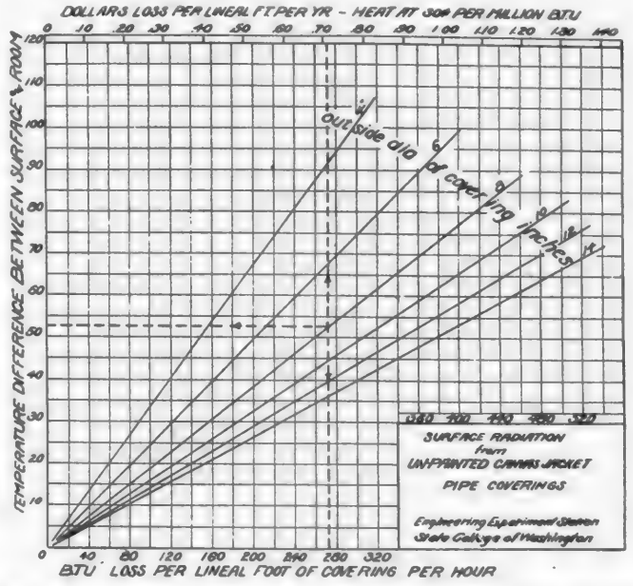

DOLLARS LOSS PER LINEAL FT PER YR - HEAT AT 30¢ PER MILLION B.T.U.
TEMPERATURE DIFFERENCE BETWEEN SURFACE & ROOM
outside dia of covering inches
SURFACE RADIATION from UNPAINTED CANVAS JACKET PIPE COVERINGS
Engineering Experiment Station State College of Washington
B.T.U. LOSS PER LINEAL FOOT OF COVERING PER HOUR

Fig. 6—Economic Losses from Pipe Coverings Determined from Surface and Air Temperatures and External Diameter of the Covering.

covering investigated, will give the approximate radiation losses in B. T. U. per hour, or dollars per year per lineal foot. A series of tests of the above method of measuring surface temperatures of pipe coverings gave an average variation of about 1¾% higher than the temperature as determined by thermo-couples. The maximum variations never exceeded 3% higher.

TIN-JACKETED COVERINGS

It is commonly known that at a given temperature a smooth, bright surface, such as tin, will radiate less heat than would be radiated from a surface of canvas or of asbestos paper. This fact suggested a further possible heat saving in the insulation of steam pipes by the substitution of a polished tin surface for the usual canvas jacket on the outside of the covering. Then a jacket of bright tin was tightly fitted over the surface of the covering and the heat loss was again measured for the same pipe temperatures. The saving in heat due to the addition of the tin surface is shown in the following table where the air temperature is at 80° F.

Pipe Temp., deg. F.	Steam Pressures, Lbs.	B. T. U. Heat Loss*		Per Cent. Saved	Saving per 100 Sq. Ft. per Year at 70c. per 1,000,000 B. T. U.
		Canvas Surface	Tin Surface		
249	15	13.6	10.7	21.3	$1.78
276½	34	17.3	14.0	21.3	2.33
294½	48	20.4	16.1	21.1	2.63
312½	67	23.1	18.1	21.6	3.06
330	89	26.1	20.2	22.6	3.62
350	126	30.4	23.5	22.7	4.23

* B. T. U. per hour per square foot of outer surface.

The above table will indicate that the saving is large enough to warrant serious consideration.

Ordinary coke IC tin costs approximately $18.00 per 100 sheets of a total area of 388 sq. ft. Allowing for lapping joints, 100 sheets will cover approximately 350 sq. ft., and, for example, allowing $17.00 for erecting, the total cost for tin jacketing the covering of a plant would be 10 cents per square foot.

For pipes operating at a steam pressure, for instance, of 126 lbs. per square inch, the saving would be 4.2 cents per square foot, or an interest on the investment of 42%. It has been assumed that only straight runs of pipe will be covered with tin and that no attempt will be made to make it water-tight.

It should be noted, in considering a tin covering, that the tin jacket affords considerable protection to the covering and justifies a reduction in the sum set aside for maintenance and depreciation on the covering. The tin, in certain cases, may also replace the canvas jacket now used on insulating coverings.

SAMPLE CALCULATION OF HEAT LOSS FROM A DOMESTIC WATER HEATING SYSTEM

In computing the heat losses from the pipes of a domestic water heating system, the temperatures used are comparatively low—approximately 160° to 200° F.—and the temperature difference between a covering surface and room temperature would be small. At such temperatures the heat loss is but little more from the cheapest covering than from the most expensive. For this reason, domestic water heating systems are usually insulated with but one thickness of air cell or similar grade covering. The boiler itself is usually covered with plastic magnesia.

A certain amount of radiation in the basement is usually desirable because a house is much better for children and easier to keep comfortable if the floor is not cold. Radiation from pipes covered with 1 in. of covering will usually warm the basement air enough to prevent freezing. Exposed pipes would keep the basement air much warmer.

Following is a sample calculation for the heat losses from a domestic heating plant, first with pipes exposed and then comparing the use of each of two different grades of covering, such as 1-in. magnesia and 1-in. air-cell. The calculation is applied to a 4-in. pipe in a basement free from cold air drafts:

Pipe temperature, 180° F.

Air temperature, 70° F.

Hours in service (8 mos. per year), 5,760.

Bare pipe losses per hour, 244.2 B. T. U. per square foot of pipe.

Bare pipe losses per 8 mos., 1,405,000 B. T. U. per square foot.

Heat costs, approximately, $10.00 per 1,000,000 B. T. U. (high because of low average furnace efficiency).

Total loss per square foot per 8 mos., $1.405.

Calculated Loss Per Sq. Ft. of 4-in Pipe Covered With 1-in. Covering

Outside diam. 4-in. pipe = 4.5-in. rad. = 2.25-in. $\log_e$ 2.25 = .8109

Outside diam. 1-in. cov. = 6.5-in. rad. = 3.25-in. log 3.25 = 1.1787

$$H = \frac{k\,(t_1 - t_2)}{r\,(\log_e r_2 - \log_e r_1)}$$

1-in magnesia:

k_1 mag = .40

t_1 = 180°

t_2 = 91° ave.

$$H = \frac{0.40\,(180 - 91)}{2.25\,(1.1787 - .8109)}$$

=43.2 B. T. U. per square foot per hour.

Total loss per square foot per year 5760×43.2×.0001=24.9c.

Cost 1-in. Magnesia, list=50.9c per square foot of pipe surface.

At 10% off list = 45.8c per square foot.

1-in. air cell:

k_1 air cell = 0.50

t_1 = 180°

t_2 = 96° ave.

$$H = \frac{0.50\,(180 - 96)}{2.25\,(1.1787 - .8109)}$$

=50.8 B. T. U. per square foot per hour.

Total loss per square foot per year 5760×50.8×.0001=29.3c.

Cost 1-in. Aircell, list,=50.9c per square foot of pipe surface.

At 45% off list = 28.1c per square foot.

Difference in savings in favor of magnesia = 4.4c per square foot per year.

Difference in first cost in favor of air cell = 17.7c per square foot.

Value of heat saved by 1-in. air cell = 140.5 — 29.3c = 111.2c, or $1.11, per square foot per year.

This shows that even here high grade covering pays a good return upon its extra cost. Usually, however, the heat lost through the cheaper covering is no more than is desired to keep the basement fairly warm.

When Steam-Heater Air is Drier Than Water-Heated Air

An expression often heard that the air in a steam-heated house is drier than in one equipped with a water heating system, is not so unreasonable as one might think. H. S. Kehm, of Kehm Bros., Chicago, in discussing this point in a recent issue of *Central Manufacturing District Magazine,* explains the matter by stating that "steam heat is very dry and the radiator very hot, since the temperature at the boiler must be at least 212° F. in order to generate steam. The steam heating system at its maximum load has a temperature of about 230° F., and, as already shown, a minimum of 212°. Hence a boiler temperature range of 18° is expected to compensate for an outside temperature range of 60° the temperature of the average winter in North America varies from about —10° to 50°, a difference of 60°.

As a result, during average weather, the building is too hot and in order to make it habitable, windows are opened.

A water heating system, on the other hand, operates efficiently at from 130° to 200° F., a temperature range of 70°. Hence, with an outside temperature of 50°, the system can be operated at 130° and, when 10° below zero, at 200°.

Fresh Air

By E. Vernon Hill

I AM old as the snow-capped mountains,
I am young as your youngest son.
I'm a wandering soul, and from pole to pole
And from ocean to ocean I roam.

I was here when the earth was in darkness,
When the land and the waters were one.
I was old before Eve had been taught to deceive,
Before men knew the meaning of sin.

I have seen nations born, grow old and decay,
I have paused at the deathbed of Kings.
Then onward I've flown to some poor peasant's home
Where peace and contentment reigns.

I journeyed o'er seas with Columbus,
I laughed at his mutinous crew,
Then bellied the sails with strong Westward gales
'Til the new world unfolded to view.

I have turned the quaint windmills of Holland,
I have quenched the parched fields with the rain,
Then stolen away on a trade wind next day
To the beckoning vineyards of Spain.

Over and under the world I have roamed
Seared by a tropical sun,
And the vast ice floes and the arctic snows
Have chilled me to the bone.

I wander green fields where cattle roam,
Peaceful the livelong day.
I soar the skies where the skylark flies
And I stop where children play.

I frequent the parks where the grass is green
And the slums with its filth and grime,
Where the dirt of the street and the stifling heat
Make a royal welcome mine.

I am clean when I blow from the poppy fields
Or the whispering woodland wild,
I am clean when I come through rain and sun
Or from the lips of a child.

But I must work as well as play,
So I toil in each busy shop.
The furnace roar would be heard no more
If my part of the work should stop.

I carry the heat from the burning coal
Which burns in my presence alone.
I carry soot, black, up the stifling stack
Ere my trip through Inferno is done.

Grimy and foul from my labors
I escape to the fields or shore
Where the surf's refrain or the driving rain
Wash and make me clean once more.

I'm the breath of life to all living things
Be it man, or tree, or flower.
Without me none would see the sun
For more than a single hour.

I am moist or dry—I am foul or clean,
I am everything man could wish.
I am young or old—I am hot or cold,
But I never—I NEVER—am FRESH!

Aerology for Amateurs and Others

The Evolution of Modern Ventilation and its Effect on Present and Future Practice

By E. Vernon Hill

Previous articles in this series are as follows: January, 1923, Historical Sketch; February, 1923, Health and Comfort Factors; March, 1923, The Manufacture and Use of Thermometers; April, 1923, Test Methods; May, 1923, Air Dust; September, 1923, Classification of Test Methods for Dust Determinations; October, 1923, Discussion of Test Methods for Dust Determinations; November, 1923, Odors; December, 1923, CO_2.

X—Air Distribution

A DISCUSSION of air distribution would be incomplete if we omitted the four classic drawings showing effects of the improper location of inlet and outlet registers in a mechanically-ventilated room. These sketches are labelled A, B, C, and D.

A. With the supply register in the floor near the wall and with the outlet at a high point on the opposite wall.

B. With both inlet and outlet registers in the floor (these are sometimes shown in the side wall at the floor line) on opposite sides of the room.

C. With the inlet at the side wall at a high point and the outlet on the opposite side of the room near the floor line.

D. Which is generally conceded to be the proper method shows the inlet register at a high point at the side wall and the outlet register at the floor line in the same wall. The trained arrows, so-called, indicate how difficult or impossible it is to obtain proper distribution of the incoming air except by the arrangement shown in D. The distribution of air in a room is not as simple as these sketches apparently indicate as there are many factors such as the temperature of the entering air, the temperature of the room, the location of the windows, doors and of exposed walls and even of the furniture in the room itself that materially affect the results obtained.

Furthermore, it should be mentioned that any illustration in either plan or elevation alone showing the behavior of the air currents is only half of the picture. It may generally be considered, however, that D is the best arrangement of the four schemes illustrated, although such perfect behavior of air currents can only be expected when all the factors are known or are under control.

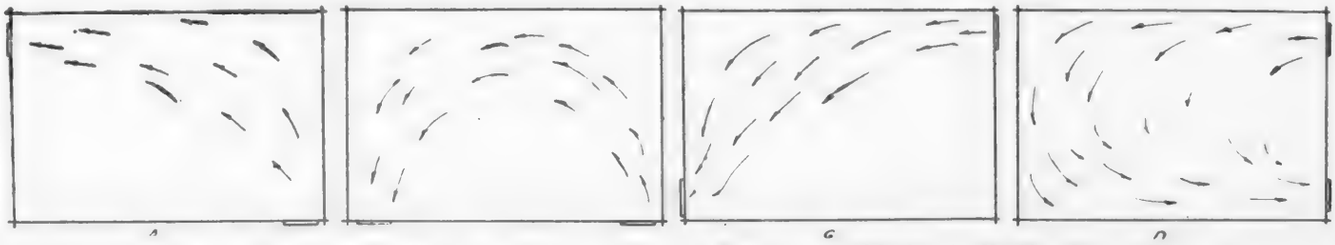
STEAM NOT A SATISFACTORY INDICATOR OF AIR CURRENTS

E. Gives some idea of how the air currents behave in a closed room equipped with the Beery system of ventilation. In this system, the supply is from a specially-designed ornamental fixture in the center of the ceiling. The exhaust is at four points in the side wall at the floor line, one register being located in each corner of the room. The inventor of this system, Clinton E. Beery, always enjoyed demonstrating the perfect distribution by introducing steam into the supply duct and watching its action as it entered the room through the diffusing supply register in the ceiling. The air and steam enters at a low velocity and, due to the design of the supply register, is distributed in every direction both laterally and downward, spreading out a few feet below its point of entrance into a uniform stratum, or blanket, which slowly descends to the floor line and escapes through the outlets in each corner of the room.

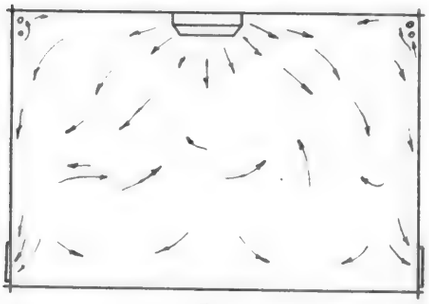
Steam, however, being lighter than air, does not give a true picture of the behavior of the air currents. On exploring the room with an A. C. machine, the distribution, although very uniform, is found to present a different picture than when the experiment is made with steam. There is a decidedly downward current on all walls, particularly those that are exposed, with an extremely variable, or "choppy" effect throughout the entire central portion of the room. If the temperature of the incoming air is automatically controlled at the proper point, the distribution is exceptionally good. If the air introduced is at too low a temperature, some complaint will arise from drafts on the heads of the occupants.

CONDITIONS NECESSARY WITH FLOOR AIR INLETS

F. Illustrates the action where the supply is from mushrooms in floor, with the outlets in the side walls at the floor line. Theoretically, this is the best method for obtaining proper distribution. Incidentally, it is the most expensive. In practice it is not as satisfactory as side-wall introduction, owing to the fact that the entering air is brought into immediate contact with the lower extremities of the occupants and unless the velocity is very low, approximately 50 ft. per minute, and unless the temperature is very carefully maintained at not less than 70° F., uncomfortable conditions are apt to prevail. It should also be noted that the humidity of the entering air bears a direct relation to its cooling effect and air of a proper temperature, but of a low humidity, may occasion complaint with this system of introduction.

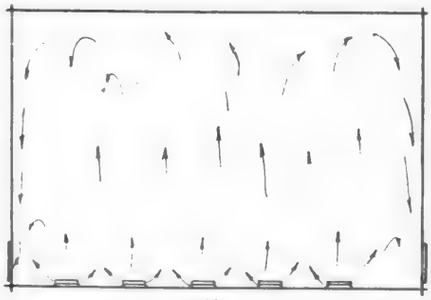


Effects of Improper Location of Inlet and Outlet Registers in Mechanically-Ventilated Room.



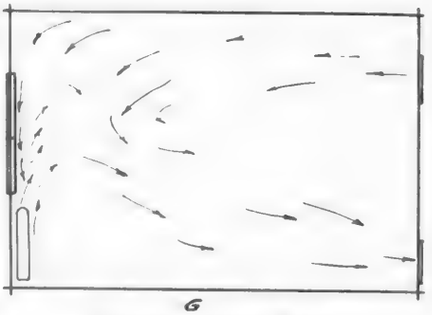
E

Direction of Air Currents With Beery System.



F

Course of Air With Mushroom Ventilation.



G

Radiator Effect With "Split" System.

RADIATOR EFFECT WITH SPLIT SYSTEM

G. Illustrates the effects of radiators located on the outside wall where the so-called "split" system is employed. The supply is on the inside wall. The upper currents of warm air from the radiator meet the downward flow of air from the register, forming eddies and whirls from 1 ft. to 2 ft. above the top of the radiator, with a general tendency for the air to pass backward across the room at this height.

RESULTS OBTAINED WITH STRAIGHT BLAST SYSTEM

H. Illustrates the effects in the straight blast system where the radiator is omitted and the air introduced at a sufficiently high temperature to take care of the heat losses. Distribution with this method is more uniform, although it is open to the objection of drafts at the floor line.

During the years that the writer was in charge of ventilation work in the Chicago Health Department, it was observed that a very considerable portion of the complaints received from schools during cold weather were from this source. The blast system is standard in Chicago schools. The air entering from the supply register on the inside wall passes directly across the room to the outside wall with its large window area. Striking this surface it is cooled and descends and sweeps backward at a temperature considerably lower than that of the average temperature of the room as a whole. The children frequently complain of cold drafts on their feet for this reason.

COURSE OF AIR WITH UNIT VENTILATORS

I. Illustration I represents the general distribution in a class room from unit ventilators. Where this system is employed, the unit is located on the outside wall in order to obtain its air supply through the lower portion of the window. Air is usually projected upward at a comparatively high velocity, usually about 1200 ft., as it leaves the machine. The air passes upward in a thin sheet and does not spread to any extent until it strikes the ceiling. Here the breaking up of the air current is not as pronounced as might be expected, the air passing directly across the room on the ceiling until the side walls are reached, where it descends downward to the outlets, usually on the inside wall. However, the air does not immediately pass through the outlets, as might be supposed, but establishes a vertical whirl as illustrated. Due to this action, the distribution is usually very good.

AIR CURRENTS IN ROOM WITH EXHAUST VENTILATION

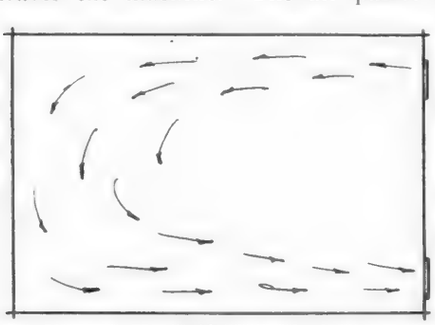
J. Illustrates the behavior of air currents in a room equipped with exhaust ventilation. Where exhaust ventilation is employed, the pressure in the room is necessarily lower than the pressure outside, consequently every opening into the room acts as an inlet and currents of air are established from each directly toward the exhaust opening. Systems of this kind are always unsatisfactory, owing to the fact that the supply cannot be controlled. Objectionable drafts, sometimes at very unexpected points, and extreme variations in temperature throughout the room are common.

HOW CROSS BEAMS IN CEILING AFFECT AIR CURRENTS

K. Illustrates the behavior of air currents in a room equipped with a unit ventilator in which cross beams in the ceiling form an important part of the architectural scheme. Considerable difficulty was encountered in this particular installation due to this unforeseen condition.

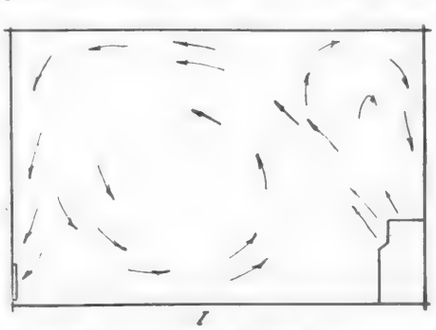
EFFECT OF WALL CASES IN SCHOOL ROOMS

L. Illustrates the behavior of air currents in Chicago schools where a large wall cases was located behind the teacher's desk as illustrated. The supply was from the opposite side of the room and the air passed across the room to the opposite wall, downward against the top of the case where it established a very distinct current about 2 ft. above the heads of the seated pupils. The front part of the room was reported as being entirely too warm and the rear portion uncomfortable on account of drafts.



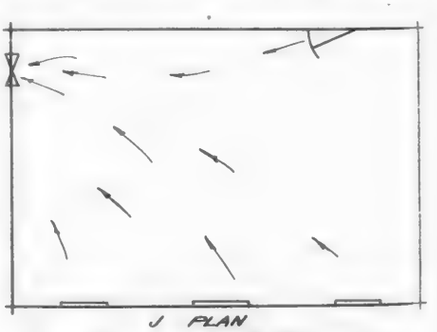
H

Effect With Straight Blast System.



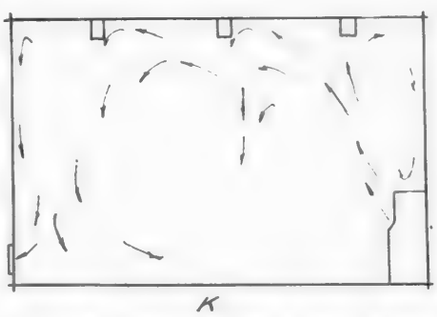
I

Air Distribution With Unit Ventilators.

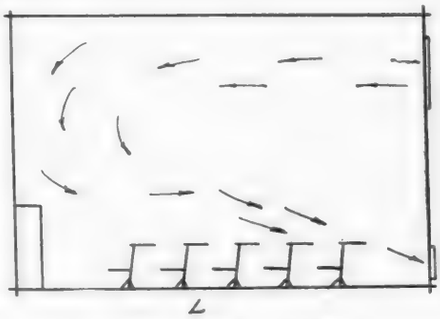


J PLAN

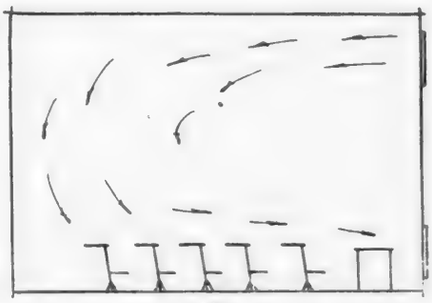
Air Currents With Exhaust Ventilation.



Effect of Ceiling Cross Beams With Unit Ventilation.



Effect of Wall Cases on Air Currents.



Arrangement That Causes Drafts on Back of Pupils' Heads.

By removing the case to the side wall, the difficulty was overcome.

AN ARRANGEMENT THAT CAUSES DRAFTS ON BACK OF PUPIL'S HEADS

M. Illustrates a somewhat common, though faulty method of air introduction and removal. The supply registers are located at the back of the teacher's desk and the air flow is supposed to be in the faces of the pupils. However, the currents are usually horizontal across the room, downward at the rear and back toward the exhaust register at the floor line, causing objectionable drafts on the backs of the heads of the seated pupils.

GOOD RESULTS WITH AIR FLOWING TOWARDS FACES OF PUPILS

N. Is a much better arrangement. Here the supply is at the back of the room, the air passing to the opposite side downward and travelling backward at the floor line in the faces of the pupils. Complaints from drafts in this arrangement are seldom encountered.

HOW AN 18-IN. OSCILLATING FAN AFFECTED A VENTILATION TEST

O. In making some tests in the Harper Memorial Library some years ago, we could not help but notice the poor distribution in the small study and research rooms throughout the building. The supply in these rooms came from side wall registers about 7 ft. above the floor with the outlet at the floor line on any wall that convenience dictated. In one room, however, the distribution was 100%, viz., the analyses of four air samples for CO_2 at four different points were identical. The method of supplying the exhaust was the same, however, as in many of the other rooms where the distribution is poor.

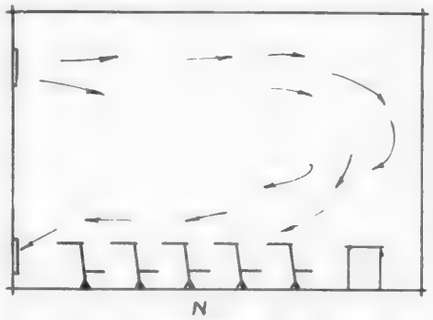
I had noted while the test was being made that an 18-in. oscillating fan was located in one corner on a book case and was in operation at the time the test was made. The distribution was apparently so markedly influenced by the operation of the fan that we repeated the test experimentally in my offices in the City Hall, verifying in each instance the original results.

This experience led me to suggest in a subsequent article on ventilation that an improvement could be made in the present method of moving air in school systems by omitting the large central fan and substituting an enclosed oscillating propeller-type fan at each supply register. This would necessitate designing the system for low velocities and low resistance throughout, and locating the reheaters at the base of each class-room riser. Such a system would give practically perfect distribution in each class-room. Moreover, it would be extremely flexible. With speed control on the individual fans, the capacity could be increased when the room was filled. It could be reduced when the room was partly filled, or shut off altogether when the room was unoccupied.

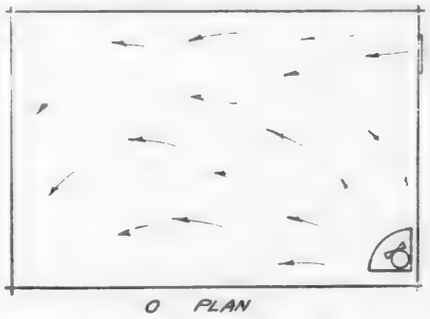
SPECIAL PROBLEMS INVOLVED IN LARGE ENCLOSURES

The distribution of air in theatres, auditoriums, dance halls and other large rooms is a much more complicated problem than in the small standard school class-rooms and, as a usual thing, it must be studied carefully and intimately if satisfactory results are to be obtained.

Considerable favor is given by many engineers to the mushroom system on account of the excellent distribution obtained in this way. However, the fact should not be lost sight of that more trouble is liable to be encountered with the mushroom system than with any other design.



Good Effect With Air Blowing Towards Faces of Pupils.



Effect of Oscillating Fan on Ventilation of Room.

EFFECT OF AIR CURRENTS ON ACOUSTICS OF CHICAGO CITY HALL COUNCIL CHAMBER

The writer recalls some experiences with the Council Chamber of the City Hall of Chicago which was designed with an individual supply under each alderman's desk. For the first year or more that the room was in service, it was practically impossible to understand what the

speaker was saying from the rostrum, or to get intelligent replies from the aldermen.

Many schemes were tried, such as the stringing of wires, etc., to improve the acoustics of the room. We finally reduced the individual air supply under each seat to less than half of its original volume, increasing correspondingly the introduction through side-wall registers. We also very carefully adjusted the velocities at each individual floor register before the bad acoustic properties of the room were finally corrected. The different velocities, temperatures and densities of currents of air passing upward from the floor to the ceiling apparently broke up or seriously disturbed the horizontal part of the sound waves.

CURRENTS OF AIR IN THEATRES SHOULD BE FROM THE FRONT

In theatres, or any rooms where the occupants are seated for a considerable length of time, the air current should always come from the front, never from the rear. Currents of air distinctly cool striking the occupants in the face are agreeable rather than otherwise, but if coming from the rear, they will cause almost immediate complaint. Introduction through the ceiling is always a dangerous procedure unless the ceiling exceeds 15 ft. or 20 ft. in height. Even then, it should be used with considerable caution.

CONDITIONS IN THE TRIANON BALL ROOM

A recent test in the Trianon Ball Room, one of the modern show places of Chicago, developed a situation not without interest. This ball room with its surrounding promenade is about 180 ft. long and 124 ft. wide, with a balcony entirely surrounding it. All of the air is introduced through an ornamental grill in the center of the dome which is about 60 ft. above the floor. The air is refrigerated and introduced in warm weather at a temperature of 70° F. with a wet-bulb varying from 55° to 65° F. The air comes downward at a high velocity, reaching the occupied zone at about 100 ft. per minute.

A person standing, or seated in the center of the ball room is uncomfortably chilled in a very short time, but of the thousands of people occupying this space during the dances, we were unable to find any, either men or women, who objected to the high velocity or cool air while dancing. On the other hand, when the music stopped and the patrons crowded the grand lobby and various reception rooms where the temperature was only a degree or so higher but the air motion almost entirely lacking, immediate complaint was encountered, illustrating the necessity for careful study of the requirements for comfort under the varying conditions of the physical state.

DETERMINING DISTRIBUTION

The best method of determining distribution of air in a room is by the CO_2 analysis. Samples of air are taken at various points and analyzed for carbon dioxide. The variation from the average of all samples taken gives the distribution on a percentage basis. The following example will serve as an illustration. Assume that four samples of air are taken at four different stations and that the analysis is as follows:

Station	Parts of Co_2 per 10,000
1	6.4
2	7.4
3	9.2
4	5.0
Average	7.0

Then the average variation from the average CO_2 equals:

$$\frac{0.6+0.4+2.2+2.0}{4}=1.3$$

Therefore, the percentage distribution=

$$100-18.6=81.4\%$$

Variation from the average at various stations

Station

$1=7.0-6.4=0.6$
$2=7.4-7.0=0.4$
$3=9.2-7.0=2.2$
$4=7.0-5.0=2.0$

The percentage of variation equals:

$$\frac{1.3\times100}{7.0}=18.6\%$$

STUDYING AIR CURRENTS

In studying air currents in small or moderate-sized rooms, the A. C. machine is perhaps the best and most convenient device. It was described and illustrated in a previous article. Puffs of smoke are liberated at various points in the current of air from supply registers in the neighborhood of doors, windows, etc., and its behavior noted. It frequently happens that this simple procedure will give information regarding the travel of air currents, their velocity, etc., that will materially aid in solving many difficulties encountered.

In large rooms, theatres, auditoriums, dance halls, etc., more information can be obtained by the use of Prof. Shepherd's counter-poised balloons. These consist of the ordinary toy rubber balloons filled with hydrogen gas by means of the Kipp generator, or from any other convenient source. The balloons are filled to capacity and weighted with a piece of tin foil on a short piece of string, or with any other convenient material, and the weight is adjusted so that when the balloon is liberated, it remains suspended or very slowly ascends in the air of the room where the test is to be made.

Ten or a dozen balloons of this kind liberated at the supply registers of a large room where air currents are to be studied is an extremely interesting and often a very profitable experiment. Their behavior is sometimes very surprising.

The writer recalls particularly a test in a large theatre where one balloon made the complete circuit of the theatre six successive times, following the identical path each trip, travelling up inside walls, across the ceiling, downward at a corner of the outside wall and proscenium arch (where many complaints had been received regarding objectionable drafts) before it finally escaped through a vent in the ceiling.

(*To be continued*)

Problems of Electric Drive For Ventilating Equipment

Noiselessness and Low Speed the Controlling Factors in Requiring Belt-Connected, Rather Than Direct—Connected Motors

By F. R. Still

Vice-President, American Blower Company

(Presented at the November meeting of the New York Section, American Institute of Electrical Engineers)

HOW to attach alternating current motors to fans and blowers which are to be used for heating and ventilating buildings, is a problem that almost every engineer spends more time uselessly trying to solve than is spent on any other engineering problem he encounters.

When installed in churches, schools, theatres, music halls or auditoriums, fans or blowers—and motors, too—must be absolutely noiseless. Hence the air velocities and the tip speeds of the impellers must not be excessive. Consequently if large volumes are to be handled, the inlet and the outlet from the fan or blower must be of rather large dimensions, in which case the impeller must be of correspondingly large diameter, which naturally implies low speed; that is, the revolutions will not be at all suited to the regular catalogued speeds and sizes of standard A. C. motors.

LIMITATIONS OF HIGH-SPEED FANS

Two or three of the fan manufacturers have recently developed what is commonly referred to as "high-speed fans." It has been determined by careful tests that these fans cannot safely be installed in buildings of the class above referred to if the tip speed of the impeller has to exceed 6,500 ft. per minute, and it is not always safe to run a fan at that speed in some such buildings. Limiting the tip speed necessarily limits the pressure a "high-speed fan" can produce, which also does not add very materially to the ease with which A. C. motors can be attached.

For example: The smallest diameter of a "high-speed" wheel which it is commercially expedient to build, is about 24 in. This would run only at about 1000 R. P. M. to equal 6,500 ft. tip speed; this would not even permit of using a 6-pole motor which commonly runs at 1140 R. P. M. full load speed.

A single-inlet fan of this size has an outlet area of 3 1/6 sq. ft. If the static pressure amounts to only 1 in. water gauge, the outlet velocity will be 1650 ft. per minute. Thus the capacity of the fan will be only 5225 cu. ft. per minute and the power required to drive it will be about 1¼ brake horse power.

An average 20-room school-house will require about 35,000 cu. ft. of air per minute. The frictional resistance of the ducts and flues usually amounts to about 1½ in. It is particularly necessary that the ventilating equipment be absolutely noiseless in a school building; it would, therefore, be necessary to keep the tip speed down to 6,000 ft. or less. The outlet velocity will then be only 975 ft. under these conditions. This would require a fan having 36 sq. ft. outlet. The wheel would be 84 in. in diameter. The speed would be 270 R. P. M. and the power required to drive it would be 10 HP. This does not fit any standard A. C. motor speed. A 24-pole motor would run at about 285 R. P. M. and a 26-pole motor would run at about 265 R. P. M. But could such a motor be built, having only 10 HP. capacity? If it could be built, who would want to build it, and who would want to pay for it if it could be obtained?

Please remember that this type of fan runs at the highest speed it is possible to make a centrifugal fan run noiselessly. There is nothing known to-day that will run any faster and approximate satisfaction.

HIGHER VELOCITIES POSSIBLE WHEN A LITTLE NOISE IS NOT OBJECTIONABLE

In office buildings, mercantile establishments, factories and other places where a little noise is not objectionable, because there are so many other noises which are much more distracting than any ordinary noise the fans will make in such buildings, higher velocities of air and higher tip speeds can be safely maintained. But even then it would be undesirable to maintain an outlet velocity above 2000 ft. per minute. Let us assume the frictional resistance to the flow of air in the ducts and flues amounted to as much as 2 in.; the tip speed would then have to be 8,500 ft. per minute, which is about the maximum it would be practical to run a fan in such buildings.

Buildings of the type just considered require from 10,000 to 60,000 cu. ft. of air per minute per unit; a fair average is around 20,000 cu. ft. This would call for a 10 sq. ft. outlet area. A fan having a 42-inch wheel has an area of 9.7 sq. ft. Thus the outlet velocity would be 2,063 ft. per minute. At 2 in. pressure, the tip speed will be 8,600 ft. The revolutions would be 780 R. P. M. and the power required to drive the fan would be 9.2 brake horse power. An 8-pole motor would run at about 860 R. P. M. and a 10-pole motor would run at about 690 R. P. M., full load speed.

If we were to select a 36 in. impeller and run it at 860 R. P. M., the tip speed would be about 8,100 ft. This fan has an outlet area of 7.06 sq. ft. The velocity for 20,000 cu. ft. would be 2,833 ft. per minute. The pressure it could overcome in this case would be only 1 in. instead of 2 in., as we previously assumed. Hence the ducts would have to be 42% larger in area to reduce the friction. The power required would be 5.3 HP.

If a 10-pole motor running at 690 R. P. M. was used, then we would use a 48 in. impeller, the outlet area being 12.5 sq. ft. To deliver 20,000 C. F. M. the velocity would be 1,600 ft. and the tip speed would be 8,675 ft. The static pressure would then be close to 3 in. The power would be 11.5 brake horse power. If the pressure

was adjusted to 2 in., then the outlet velocity would be 2,100 ft. hence the volume delivered would amount to 26,250 C. F. M., or about 30% more air than was actually required. The power would also increase about 30% as it will amount to 11.85 brake horse power.

If we used the 42 in. impeller that we first figured on, and ran it at 860 R. P. M., instead of 780 R. P. M., as we calculated it should run, the tip speed would be 9,460 ft. when delivering 20,000 C. F. M.; the static pressure would be about 2.8 in. and the power about 12.15 HP. If the pressure was adjusted to 2 in., then the volume would amount to 23,800 cu. ft. per minute, the power still remaining at 12.15 HP.

ADAPTABILITY OF HIGH-SPEED FANS FOR FORCED DRAFT

When fans of this type are used for forced draft in connection with stokers under boilers, noise is usually not a serious factor for consideration. As the pressures required for such work vary from 4 in. to 7 in., usually ranging between 5 and 6 in., and the tip speed frequently being from 12,000 to 15,000 ft. per minute for such duty, the "high-speed fan" lends itself to direct-connected A. C. motors very nicely. For such applications the fan is particularly well adapted, as it has no over-loading factor for a considerable range of volumes when running at a constant speed.

For example; Starting at 7 in. pressure, and assuming a constant speed, the power only increases 12-½% when the outlet velocity varies from 2,000 ft. up to 3,000 ft. velocity; from that point on up to a full open discharge, when the velocity would be about 4,500 ft. per minute, the power will fall back 12-½% again. This is exactly the opposite of what happens with any other type of fan, as the power required to drive all other types increases very rapidly as the resistance is removed, until it sometimes amounts to two or three times the amount of power required at the normal load.

DANGER OF OVERLOADING THE MOTORS WITH SLOW-SPEED FANS

As a safeguard against overloading the motors, it is, therefore, necessary to add from 25% to 50% to the normal rating when selecting a motor for "slow-speed fans" to insure against burning out the motor in the event that the resistance is not as much as was calculated when the normal amount of power was determined. This is not necessary with fans of the "high-speed" type. They are necessarily much larger than "slow-speed fans," as the latter move air faster at a given speed, hence smaller impellers are required. They are about one-third larger for a given duty. They are also much more expensive, costing from 50% to 100% more for a given size and duty, depending upon the speed they have to run and the stresses they will be subjected to. However, due to the smaller motor frame, the combined cost of this "high-speed fan" with a less costly motor results in a net saving of anywhere from 25% to 40% on the complete unit.

BELT DRIVE FROM A. C. MOTORS PREFERRED FOR SLOW-SPEED FANS

Where A. C. motors have to be used for driving fans in public buildings, wherein noiselessness is so essential, it is advisable to install a "slow-speed fan" and drive it by a belt from an A. C. motor. Where direct current is available, combinations can be arrived at very easily which will permit of using direct-connected motors.

For industrial purposes, the "high-speed fan" can be employed with direct-connected A. C. motors in almost every case. It is not recommended for ordinary heating and ventilating plants in any type of building, because the velocities will have to be unnecessarily high, thus being costly to operate. Nothing is gained in first cost, space or power. The only advantage would be the elimination of the belt between the motor and the fan, which is not of such importance as to warrant the trouble and the expense involved.

Belts have been known to last for years in ventilating plants. Such trouble as has been encountered has usually been due to the belt being too narrow or too light or of a quality too poor for the power it had to transmit. If a belt is large enough, well selected and well made, it is a very efficient and satisfactory means of transmitting the power. It is often far more satisfactory than many of the directed-connected outfits which have been carelessly erected, not being properly anchored down to a good foundation and never properly aligned. A whole lot of trouble and expense will be avoided by all parties connected with most heating and ventilating installations if a more favorable attitude is assumed toward belted motors than has been the custom for some years past.

Ventilation of Garages in Building Basements

Present day practice seems to be tending toward the construction of garages in the basements of office buildings and large apartment houses, and this opens up a new problem in ventilation. A new code is in preparation in Washington, D. C., which will probably embody requirements in the way of ventilation for basement garages.

In response to a request by Albert L. Harris, municipal architect for the District of Columbia, who is also chairman of a board which is preparing this new building code, the following views have been expressed on the subject by Nelson S. Thompson, chief engineer, Office of Supervising Architect, Treasury Department:

"My idea of the proposition is that the dangers to be anticipated from so constructing garages have been greatly exaggerated, especially from the standpoint of ventilation. This being a new departure in the engineering field, those taking the first steps are inclined to overrate the difficulties of the problem, and in order to keep themselves safe and above criticism are very apt to go to unnecessary expense in the matter of installing fans and other apparatus.

An office building in a city is of necessity a high building, and, being high, is a natural chimney, with a tendency to pump the air from the lower floors into the upper floors by the action of gravity and the operation of elevators, etc., so that above a certain neutral zone in the building the air escapes outward. I have tested the air many times in such buildings, and found that the flow of air was from the basement doors in, and then, with leakage from the outside to the inside, the air flowed upward to somewhere about midheight of the building, where a neutral zone existed. Above this neutral the tendency was to flow outward, this tendency increasing with the height.

"Under these conditions it is obvious that to prevent

the fumes from the garage in the basement from issuing into the occupied portion of the building it will be absolutely necessary to seal off, as far as possible, all points of ingress for the air from the basement portion. There should be no stairway leading down from the interior of the building to the basement garage space, unless it is cut off absolutely.

"Thus, if you have to have a stairway down to the garage, my idea would be to have an open entrance vestibule with storm-doors leading into the first floor, for ingress to the upper floors of the building, and a stairway leading from this open vestibule down into the basement garage, this stairway to be closed in and having self-closing doors to prevent as much as possible the fouling of the air in the open entrance area. In fact, I do not see why a stairway is necessary at all.

"In spite of the fact that, as stated by Professor Yandell Henderson, professor of applied physiology at Yale College, the blood has power to absorb three or four hundred times the amount of carbon monoxide that it will absorb of oxygen, and that when the blood is fairly well saturated with carbon monoxide he does not know how long it would take under natural conditions for it to oxidize out, I feel that the means which have been outlined by engineers for taking care of this new problem of garage construction have gone to unnecessary refinement.

"It would nevertheless be the part of wisdom, until the real practical facts have been worked out, to introduce into the building code some regulations governing the ventilation of these spaces, with the distinct statement that they are purely tentative and subject to amendment upon the development of further knowledge concerning the matter. I think the following requirements are basic:

BASIC REQUIREMENTS

"1. I would insist that from these basement garage spaces there should be led at least two large ventilating flues, air tight in construction, up into the attic space, where they should be connected to a multiblade fan discharging outboard. No other connections to these fans should be permitted. The area of the shafts should be based upon changing the air not less than six times per hour at a speed of not to exceed 1,000 ft. per minute in the shaft.

"The fans should be absolutely standard, with standard control, motor-driven, and hand-controlled. If desired, they might be provided with remote control, so that they could be stopped and started from the garage in the basement. The idea of having two or more fans, one steam-driven and one electric-driven, with a number of automatic devices to come into play under purely theoretical conditions, seems to me to be unnecessary.

2. I also think that fully 90% of the expensive air ducts used in the schemes to date to distribute the air throughout these garage spaces are unnecessary, both as air flues and vent flues. Until we get further information on the proposition, I suggest that the tentative code be (and that it be frankly tentative) that these spaces shall be provided with fresh-air fans at a sufficient number of points, discharging air at or near the floor level, to insure the sweeping out of carbon monoxide gas, on the principle of about six changes of air per hour in the garage.

"The two or more ventilating shafts referred to previously should be provided at or near the ceiling of the garage with wire grilles.

"I have an idea that after observation on one or two of these basement garages, the whole proposition of ventilation will be handled by the installation in one or two of the basement windows of the ordinary reversible-type propeller fans for the introduction or discharge of air, probably supplemented by one or two generous vent flues, leading up to a vent in the attic to overcome the chimney effect of the building, in event of any failure to properly seal the basement off from the upper portion of the building.

"No matter what scheme is adopted, it certainly will be incumbent on the owners of the buildings to devise drastic rules for the guidance of the automobile owners in regard to bringing their cars in properly without smoke or the undue production of carbon monoxide, and leaving the garage without the usual machine-gun firing that we expect to hear about the time we are trying to get to sleep, and the consequent discharge of a lot of unburned or partially-burned gas. They should be required to learn to operate their machines quietly and with proper combustion.

About 90% of car drivers are incompetent to run a gas engine, so far as the proper burning of gas is concerned; but if proper rules are enforced the ventilation will be comparatively simple.

"We must always keep in mind in this connection the effect of gravity, which works all the time."

What is Wrong With Central Vacuum Cleaning Systems?

To take this as a subject, is to admit that something is wrong. In order to bring out all the facts a short résumé of the vacuum cleaning industry, from its inception seems necessary:

About 1900, David T. Kenney, a New York plumbing contractor, conceived the idea of removing dust and dirt from rugs and carpets by air. He succeeded in securing what, after extensive and expensive litigation, proved to be a basic patent of so-called "vacuum-cleaning." Inventions of pneumatic cleaners antedated Kenney's patent by many years, but all used brushes to stir up the dust and air as a carrying medium only.

Kenney's one claim that proved basic in its idea was "a long narrow slot in sealing contact with the surface." All previous attempts had been made with tools raised from the floor. As is usual with untried patents, one company after another came into the field, ignoring claims, and each with more or less specious arguments, claiming their machines to be the best.

In those days, the woods were full of salesmen selling central vacuum cleaning systems, and for a while almost every office building then erected was equipped with a central system. Most of the salesmen were selling on commission. If an order could be had without competition, both barrels were loaded and the machine and equipment were usually far in excess of the needs of the building.

If competition were keen, then a one-sweeper plant magically became a two-or three-sweeper, and a two-sweeper plant anywhere up to five or six sweeper, and so on.

LACK OF ENGINEERING IN EARLY APPLICATIONS

Almost unbelievably practically no attention was paid at that time to the engineering details of the system—with special reference to the installation of the piping. Each company tried to make its pipe sizes as small as possible so that the total cost would be under the other fellow's; in other words, it was a case of "caveat emptor," or, let the buyer beware.

The tools then used were heavy, cumbersome, and inefficient. They were rigidly attached to the handles, and the furniture had to be moved, in order to clean under it. The hose had to stand a vacuum of 29 in. mercury and was very heavy. The size was usually ¾ or 1 in. and the fractional loss of air from this small hose reduced cleaning efficiency at least 50%.

Due to the custom of installing rising lines, in some cases of 1½ in. and never over 2 in. in diameter, and the same size from top to bottom, the upper floors of any high building had just about enough suction to take in a little cigarette smoke, if the valve were open.

CARELESS INSTALLATION OF PIPING

No one cared much how the piping was installed. If a recessed drainage fitting was not available, then a water-or steam-fitting was used, and, as likely as not, headed in the wrong direction. Practically every machine then on the market was of the high-vacuum pump type. The positive pump type has too inherent faults when used for vacuum cleaning.

The power consumed is not regulated by the amount of air delivered, but by the inches of vacuum produced; so that with fewer than the number of sweepers than the plant was designed to operate being used, the power consumed was always at full load.

The second fault was, that the pump was always producing the highest vacuum possible, and with only a partial load the vacuum at the tool-end was far in excess of that necessary and the cleaning tool sealed tightly to the carpet. Thus the cleaning became laborious and, to some extent, injurious.

One company after another, then in business, went into bankruptcy, and service could not be had and repair parts were either impossible to secure or were only procurable at a very high cost. Is it any wonder, that the central vacuum cleaning system is regarded by most people as a proven failure?

APPEARANCE OF PORTABLE-TYPE CLEANER

The portable-type cleaner made its appearance after a few years and, in the small household type, met with great success and a tremendous volume of business.

Portable cleaners of what we may term "heavy-duty type" were also being sold and, in comparison with the old installations of central systems, were found to be more convenient and of lower first cost. There were no pipe stoppages and the cleaning was as efficient on the top floor as on the first.

We admit that to-day at least 80% of the building managers believe that the portable vacuum cleaner is superior to the central system, but the portable cleaner is basically and economically wrong to clean with, commercially, at any time.

First: It is unsanitary. The basic idea of vacuum cleaning was improved sanitation. The portable cleaner defeats this by taking the clean air into the machine, mixing it with the filth found on the floor, and then discharging the air (which is then very foul) directly back where the cleaning is being done.

Second: It is economically wrong; as it must and does take longer to clean with than a central system properly installed. Due to the necessity of keeping the weight of the machine within certain limits, so that it may be moved easily, the cleaning efficiency at the tool-end is reduced to not over 60% to that of the central system.

The length of hose used with the portable cleaner is usually not over 25 ft., and the machine must be moved after cleaning the radius which this will cover. The machine must be moved from floor to floor. This takes a considerable amount of time and the use of an elevator. Not only is hose used, but also 50 ft. of cable cord, which has to be coiled up for each move.

The machines rarely see the engine room and do not, as a rule, receive proper mechanical attention.

Each machine has a dirty bag, which, to maintain proper cleaning efficiency, should be cleaned several times each night.

The depreciation charge on the portable cleaner, as compared with the modern central system, is at least double.

CENTRAL VACUUM CLEANING SYSTEMS AGAIN IN FAVOR

The sale of central vacuum cleaning systems, after having reached its low point, is having a steady and healthy growth. Those companies in business today do not wish to make a sale unless the piping is installed in accordance with recognized standards. The pipe sizes must be such as will eliminate frictional loss and stoppages and give equal cleaning value in any part of the building. There must be sufficient rising lines, so that not over 50 ft. of hose need be used per sweeper.

Without any auxiliary devices, the machine must maintain a constant vacuum, so that with one and up to the full number of operators the vacuum will be the same at the tool-end; always enough—never too much.

The power used is in direct proportion to the number of tools in use at one time. The hose is light in weight. The tools are swiveled, so that it is not necessary to move any furniture as the tools will clean under any of the so-called "sanitary" desks.

Any dust that may escape the separator can pass through the machine without causing injury, and complicated water separators have been eliminated. Motors are direct connected; belts, gears, etc., discarded.

APPLICATION OF VACUUM CLEANING TO BARE FLOORS

Central vacuum cleaning, in the early days, was looked on as a luxury, applicable to the cleaning of carpets and rugs only. Today, at least 70% of the cleaning done by this method is on bare floors of all types. As evidence of this, thousands of public schools are equipped with central plants and each schoolroom is vacuum-cleaned daily. No type of room offers more difficulty in handling hose and cleaning tools than a schoolroom with forty or more small desks.

Repeated tests have shown that a schoolroom can be vacuum-cleaned in half the time taken with the broom, despite the fact that the tool is narrower than the brush used and the operator has 50 ft. of hose to contend with.

The vacuum cleaner tool can be moved over the surface at any speed within the physical limits of the operator, and it cleans in both directions.—EDWIN J. SKILLMAN in the *New York Building Superintendent.*

Back To First Principles

Plain Answers to Direct Questions on Present-Day Heating and Ventilating Practice

By T. W. Reynolds

1. Q. What are the disadvantages resulting from air in steam and water radiators?

A. Air in contact with radiating surfaces is cold as the air and steam having different densities will not mix, neither will the air circulate so as to heat up by contact with the steam or water. This reduces the effective radiating surface, perhaps as much as one-third or one-half in the case of steam radiators, depending upon the form of heater. Moreover, just as two bodies cannot occupy the same space at the same time, so the air must be driven out of the system before steam or water can enter and circulate, and so reach and warm all radiating surfaces. Thus, in steam systems the slow discharge of the air prevents the system from quickly heating up whenever pressure is raised. The amount of air in such systems is said to be, under some conditions, about 0.10 cu. in. per square foot of radiation per hour.

It should also be remembered that the presence of air at atmospheric pressure in a steam system will prevent the system from being operated under partial vacuum (pressures below atmosphere.) Consequently, no advantage can be taken of the economy obtainable by means of lower temperatures at radiating surfaces in moderate weather, as would be possible if the radiators were equipped with air valves of the type preventing the return of air.

2. Q. How does air get into a steam or water heating system?

A. Part of the air is supplied by the water entering the system. In steam systems a certain amount of air is released from the water in the boiler upon heating, but where no new water is introduced this air is soon expelled from the system. Hot water systems, if emptied of water in the summer, will fill with air and in steam systems, the steam condensing (when pressure is lowered or steam turned off) causes a vacuum which draws in air at the air valves, bonnets of radiator valves, or other points.

3. Q. What devices are used for ridding radiators of air?

A. Air valves, either of the automatic or positive type. The positive air valve, also referred to as a compression air valve, is the simplest form, being similar in outward appearance to the ordinary pet cock. It closes positively, as it is operated by compressing with the hand. This valve can be had with several forms of handles, but more usually it is equipped with a lock and shield and provided with a detached key (Fig. 1). The automatic type functions continuously and is designed to automatically expel the air from the radiator to which it is attached (see Fig. 3).

4. Q. On what kind of heating systems are automatic air valves used and why?

A. Steam systems, other than vapor or vacuum, as the air re-entering the system (under conditions of slight vacuum, as when pressure is lowered) must be driven out when pressure is raised before steam can refill the radiators and piping. Because of these intermittent conditions, a valve giving an automatic discharge of air is used, one that obviates the constant manipulation otherwise required with the positive type.

Sometimes automatic hot water valves are used on radiators in water heating systems, but they offer no great

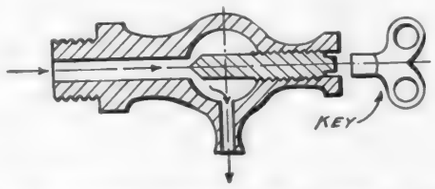


Fig. 1—Manually-Operated Hot Water Air Valve for Radiators.

advantages on such work and are liable to pass water as well as air. One example of such use would be where a water radiator (having poor circulation due to improper connections, or other reasons) might be neglected and left air-bound and cold, particularly if the installation was somewhat extensive. If used, they should be connected to a shut-off cock placed between the air valve and radiator, so that the cock may be closed quickly, should the valve flood.

A valve of this type is shown in Fig. 2. With air in the valve, the float lowers and, acting on the lever, uncovers the upper end of the tube. The air leaves at "A"; but when water enters the valve, the float rises, closing the outlet until the float is again surrounded by air.

5. Q. On what kind of heating systems are positive air valves used and why?

A. Hot water systems, as all that is required is the discharge of air when the system is being filled with water. After this has been done, some air may enter with make-up water, especially with new water introduced in considerable quantities from time to time. However, as air is lighter than water, it tends to rise so that a good portion of the air leaves the system by way of the open expansion tank. On the other hand, if air should enter any of the radiators, the air valves on such radiators must be opened again. Of course, this does not apply in the case of radiators in down-feed water

Although many of the topics presented in this department will be familiar, no doubt, to our readers, we dare say their discussion from the standpoint of the principles involved, will be found interesting reading and may help to refresh the memories of many who have taken things for granted when it came to the operation of a given apparatus or appliance. Even the more experienced engineers, it is hoped, will at times find suggestions here which will be of practical value to them.

So far as possible, the questions and answers are arranged in logical order. The form adopted of question and answer will serve as a ready reference for the numerous details encountered in the design and construction of heating and ventilating systems.

heating systems having top supply and bottom return connections, as no air valves are required for such conditions.

6. Q. What would be the objection to the use of automatic air valves on water radiators?

A. The greater liability of such valves flooding the surroundings, especially in buildings of several stories where the static head (pressure) of the water above a valve might cause the float of the valve to jam and so prevent the valve from functioning.

7. Q. what features should a good air valve possess?

A. The heat given off by steam radiation is largely dependent upon the proper operation of the air valves. Consequently, an air valve should be so designed and constructed that it will without attention automatically maintain steam in the radiator to which it is attached by freeing the radiator of all air (whether originally in the radiator or formed by condensation) without the slightest steam or water leakage.

The expansion member of the valve should keep the vent port, at the proper times, either wide open or closed

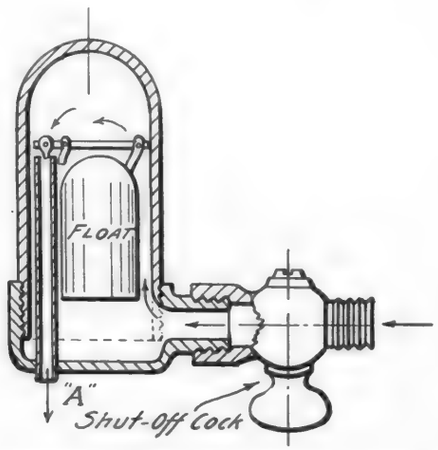


Fig. 2—Automatic Float-Operated Air Valve for Water Radiators.

tightly (whichever is required) with no intermediate position, otherwise there is a hissing sound from the partly closed vent or a loss in heating efficiency from premature closing. Nor should this member vary from time to time in its degree of expansion, in other words, the valve should be non-adjustable.

Condensation taking place within the valve should automatically drain back into the radiator by means of a separate passage, such as a siphon or drain tube, as otherwise the vacuum resulting from the steam condensing may cause water logging of the float and consequent closing of the vent port. Air and water should be separated within the air valve, the water flowing back into the radiator while the air passes out through a separate passage without any accompanying spit of water.

8. Q. How do automatic air valves on radiators prevent the passage of steam and water while permitting the flow of air?

A. Automatic air valves are made so as to open when cold and close when hot, that is, a post or tube of carbon, hard rubber, or composite material; or some kind of sensitive metal or liquid is used in the valve which will contract and open the valve to permit the passage of the air, but expand and close when the hot steam reaches it. In most valves water is prevented from passing by means of a float constructed of light material, so as to close quickly with any sudden rush of water. One type having a combination of expansion post and float is shown in Fig. 3.

Another type which has its advocates is shown in Fig.

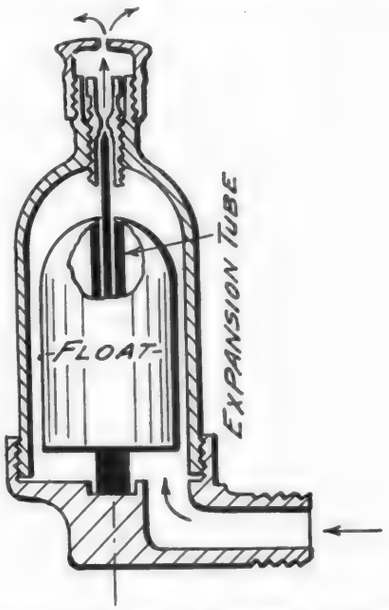


Fig. 3—Automatic Steam Radiator Air Valve With Expansion Post and Float.

4. In this the expansion post is made of a composite material, which when heated will expand more rapidly than metal. One end of the expansion post is secured to the threaded plug, which may be screwed in or out, thus placing the other end of the post close to the outlet against which it expands when heated. By adjusting the screw, air will be retained within the radiator according to the adjustment, thereby limiting the amount of steam entering the radiator; consequently, the heating effect may be reduced, as is sometimes desired during the night, or at other times.

Valves of this type may be obtained which can be used,

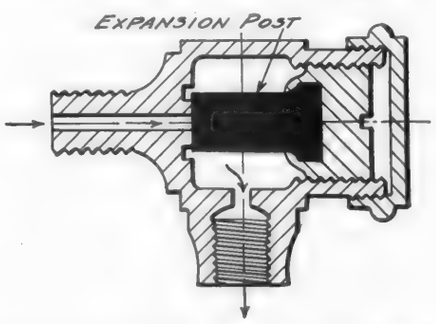


Fig. 4—Automatic Steam Radiator Air Valve of the Expansion Post Type.

either as an automatic or positive valve. When air has been driven from the system by raising the pressure, such valves may be closed and with the fire banked, so as to supply but little steam; the steam will condense faster than supplied, thereby causing a vacuum, which in a tight system can be carried over night. This allows steam to circulate to all radiators at low temperatures, so that less coal will be burned while the system will be uniformly heated throughout. Obviously, this result can

also be obtained with the ordinary positive type of air valve.

9. Q. How do air valves of the siphon type operate?

A. Air valves differ in details and construction, whether of the siphon or other type, although all have the same underlying principle in using the expansive force, either of composition parts, or of gas within a metal container. As it is not feasible here to describe all valves of the siphon type, only the make illustrated in Fig. 5 will be described.

Referring to the sketch, the combined thermostat and float (9) is sealed and contains a sensitive liquid which vaporizes when the float is in contact with steam. Vaporization commences at temperatures above 180° F. and

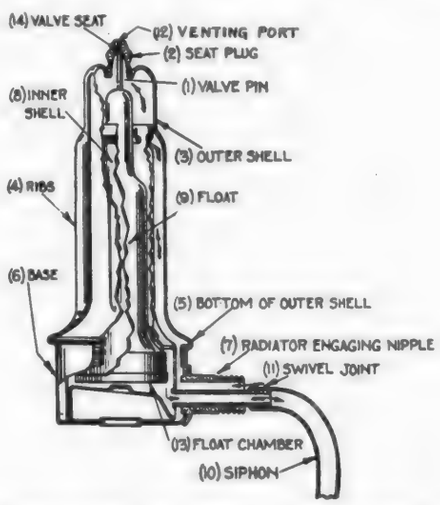


Fig. 5—Automatic Air Valve of the Siphon Type for Steam Radiators.

generates sufficient pressure when about 207° is reached to overcome atmospheric pressure and deflect the diaphragm forming the float bottom, thereby closing the vent port (12) against the escape of steam.

The seat of the valve or vent port (12) is ground so as to close tight as long as water remains against the float. When the water in the radiator drops away from the valve, the siphon (10) discharges the water in the valve back into the radiator and the valve resumes venting. Air passes into the valve as indicated by arrows, the inner shell (8) making a glove fit with the outer shell (3), so that four separate passages are made for air inside of the four bosses (4).

10. Q. What type of air valve may be used which will prevent air from entering the radiators through the air valves, and how does it operate?

A. An automatic combined air and vacuum valve,—a one way valve, that is, a type of air valve which will expel the air, but prevent its return, as would otherwise occur through the ordinary two-way air valve whenever steam condensed and formed a vacuum in the radiator. However, such valves will not prevent a certain amount of air from entering through pipe joints, or at other points, if the system remains under vacuum for any length of time.

11. Q. How do combined air and vacuum valves of the siphon type operate?

A. In general, the same as the ordinary type of air valve, except for the addition of some device closing against re-entry of air whenever pressure in the radiator is below that of the atmosphere.

For example, the one shown in Fig. 6 operates the same under steam and water conditions, as the one shown in Fig. 5, but for the removal of air; the operation is somewhat different. Thus, the upward tension of the spring diaphragm (1) raising the float (4) holds the float pin (5) tight against its seat, but when pressure is raised to about 6 oz., the upward tension of the spring (3) is overcome, deflecting the diaphragm (1), thus causing the float (4) to lower and open the valve port (6) so as to vent the radiator.

When pressure goes off the valve automatically closes against re-entry of air, closing tighter as the vacuum increases in the radiator because of the upward atmospheric pressure acting through the open chamber port (7) against the lower diaphragm (1).

The operation described is effected by pressure only and not by temperature,—pressure opens the valve and lack of pressure closes it. However, for other than air conditions, temperature plays its part, deflecting the diaphragm forming the bottom of the float (4), so as to

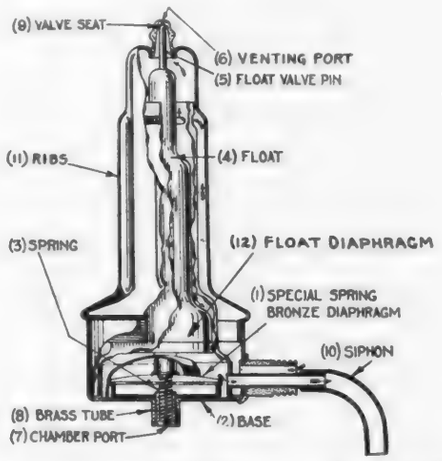


Fig. 6—Combined Automatic Air and Vacuum Valve for Steam Radiators.

close the valve when the float is in contact with steam as previously described for Fig. 5. From this it will be seen that the diaphragm (1) and the open chamber port (7) are the only additional features of the valve over the one shown in Fig. 5.

12. Q. If combined air and vacuum valves are used on steam radiators, at what points does air finally enter the system, not considering air introduced in new water?

A. When a vacuum is created in the system, air is drawn in through the stuffing boxes of the radiator valves, though a certain amount of air also enters at gauge or try-cocks, safety valves, pipe joints, sandholes of fittings and the rubber diaphragm (if cracked and old) of the damper regulator.

13. Q. How may a steam heating system be made tight so as to prevent the re-entry of air?

A. By using packless radiators valves, though ordinary radiator valves if properly repacked will help, the valves being repacked, whether old or new, so as to prevent all air leaks through the stem stuffing box.

(To be continued)

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ANY doubt that the warm-air furnace manufacturers mean business in their efforts to get at the fundamental facts regarding this method of heating is dispelled by the announcement that the National Warm-Air Heating and Ventilating Association has voted to build a $25,000 Educational Research Building to be used solely for tests supplementing those being conducted, under the auspices of the association, at the University of Illinois. So far, these tests, which are confined strictly to warm-air furnace systems of heating, have been necessarily more or less of a laboratory nature, although, it is true, actual installation conditions have been duplicated as far as possible. Practical men, however, who compose so large a part of the furnace industry, always find difficulty in accepting the results of such tests as having some "kink" to them which might not apply in actual practice.

There is no doubt that field observations have infinitely more authority than those made under artificial conditions, so to speak, provided, of course, they are made with the same care and by equally competent men. These requisites are met in the case of the Educational Research Residence of the warm-air furnace manufacturers so that we may confidently look forward to the accumulation of data in this field which will settle the requirements for warm-air furnace installations, as well as the comparative status of this method of heating.

PROCEEDING along somewhat different lines, the American Society of Heating and Ventilating Engineers has supplemented its Research Laboratory work with "field" investigations, but these, for the most part, are still circumscribed by "laboratory conditions." Heating engineers could well take a leaf out of the book of the furnace men in this respect and provide, in their own future plans, for some such structure for field investigations as the Educational Research Building. Certainly, if any benefactor is to come forward, as has been predicted, with an endowment which would assure the permanent continuance of the A. S. H. & V. E. Research Laboratory, the society would be missing its "main chance" if it did not have ready fully-worked out plans for a full-sized model experimental building in which every phase of heating and ventilation could be studied "in the field."

EVERY move on the part of industry to further research work brings into sharper relief the foresight and wisdom of the heating and ventilating industry in providing for basic investigations in its own field. Those who still doubt the immense practical value of pure research work, and there are many of them, must be impressed as more and more industries are added to those which have shown the way in this matter.

The same thing is true of commercial research work. Impressive evidence of this is to be found in the report of a committee of the National Warm-Air Heating and Ventilating Association. "Without exception," states the committee, after a survey of the industrial field, "we find that where research associations covering the commercial activities of an industry have been established, the trade possibilities of such industries have been greatly increased and brought to higher standards, not only in the production of the product, but in the sale and marketing of same, as well as the maintenance and operation of the commodities." The committee goes on to cite the cement, lumber, leather, glass, paint, brass and copper, zinc, furniture, electric appliance, and plumbing industries, all of which have gone into various phases of trade extension.

Some good doctrine for heating men generally is to be found in the committee's statement that "the architect, the builder and the consumer must, through educational advancement, be given a better understanding of the necessity of giving the heating and ventilating of the home more consideration or, at least, as much as the plumbing, electric wiring, and the other component parts of the home, since it is a fact that the heating and ventilating of a home is the most essential factor in the health, comfort and happiness of the occupants of the home."

As stated on another page, the result of the committee's recommendations is the establishment of a trade extension bureau for the warm-air heating industry, modeled in part on the National Trade Extension Bureau of the heating and plumbing industries.

READERS who desire separate copies of the yearly index of THE HEATING AND VENTILATING MAGAZINE, printed in this issue, for their bound volumes, may obtain them gratis on request. Bound volumes for 1923 are now available at $4.00 postpaid. They are made up of the reading pages only, unless otherwise ordered, and, of course, include the full cross index.

How To Use A Psychrometric Chart

Many of the mysteries associated with the psychrometric chart are brushed aside in a presentation of the subject of "Heat and Humidity Control in Buildings," by E. T. Murphy, of the Carrier Engineering Corporation, before the Philadelphia Chapter of the American Society of Heating and Ventilating Engineers. His paper in full is published in the *Journal* of the society for October, 1923.

Mr. Murphy attracted the attention of his hearers at once with the statement that "it is astonishing how recent is the development of the idea of housing industry in its own climate. For hundreds of years the industry had gone to the favorable climate, enriching some and keeping others in poverty."

Mr. Murphy expressed the terms used in air conditioning work from a little different viewpoint than is general at present:

First, there is a dry-bulb of the mercury or other liquid thermometer which is familiar and which, by the way, is of no use at all by itself. The standard is arbitrary and only a means of comparison. Heat, being molecular motion, the observed difference of dry-bulb temperatures only indicates the rate of flow from one condition to the other, just as the head or water pressure or voltage in electricity indicates the pressure available. There is nothing quantitative about it, and consequently the reading is comparatively useless alone.

Second, is the wet-bulb temperature which *is* quantitative and therefore extremely useful. This can be readily observed by placing a wet wicking on the ordinary dry-bulb thermometer with air circulated over it. This gives a depressed reading, proportional to the evaporation of the water from the wicking. As this temperature reading is the result of the sum of the latent and sensible heat in the air and vapor it indicates the total heat present. In fact, a wet thermometer could easily be calibrated in terms of total heat above zero or any other base. No calculations are possible without first obtaining a knowledge of the wet-bulb, and yet curiously general interest in this reading is comparatively recent.

Third, is relative humidity which everyone talks about and which occupies a position in all weather reports out of proportion to its real significance. It is only a ratio and is really an expression of the superheat present, as in steam on a temperature plane more familiar to you all. Suppose the mixture of water vapor and air is saturated at 50° F. and then superheated to 70° in the absence of water. It is then one-half saturated or the relative humidity is 50%.

Fourth, absolute humidity is the statement of the weight of water vapor present in the air and is usually expressed either in grains per cubic foot or per pound of air.

Fifth, the dew-point is the saturation temperature. No more water vapor can be held in the space at the same pressure and temperature. If you remove heat it must condense just like steam always does when it is saturated and cooled.

Sixth, vapor pressure is the term usually treated with discreet silence, but without reason as there is no great mystery about it. The atmospheric pressure is made up of the sum of the vapor (steam) pressure and the column of the air which can be likened to a container, so there must necessarily be a definite pressure for each saturation temperature, just as there is in a boiler, with the modification that this boiler is elastic and explodes at the boiling point.

After explaining the use of the sling psychrometer with its wet and dry bulbs, he assumed a case where the wet wick shows 71° F. and the dry-bulb 90° F. With these figures, he said, the drying characteristics of the air in which the instrument was slung are immediately known. A cubic foot of air is cooled approximately 8½° for each grain of water evaporated and since the wet-bulb is the limit of evaporative cooling, 19° are available which, when divided by 8½, leaves for evaporation about 2¾ grains per cubic foot, if the drying devices were 100% efficient, as in the case of a spray-type humidifier. Of course, the average dryer does not run much over 60% efficient.

(*Continued on Page 68*)

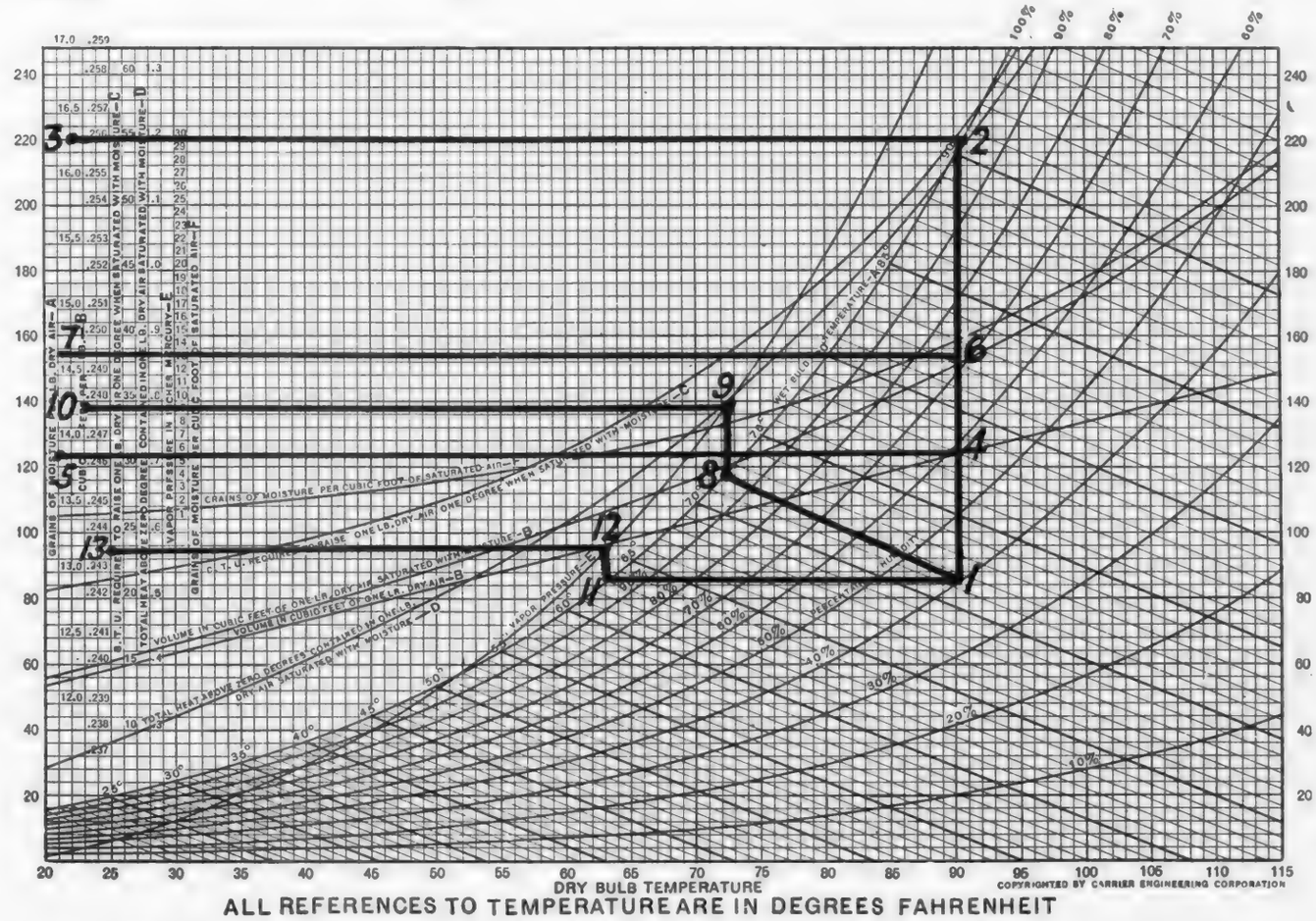
DRY BULB TEMPERATURE
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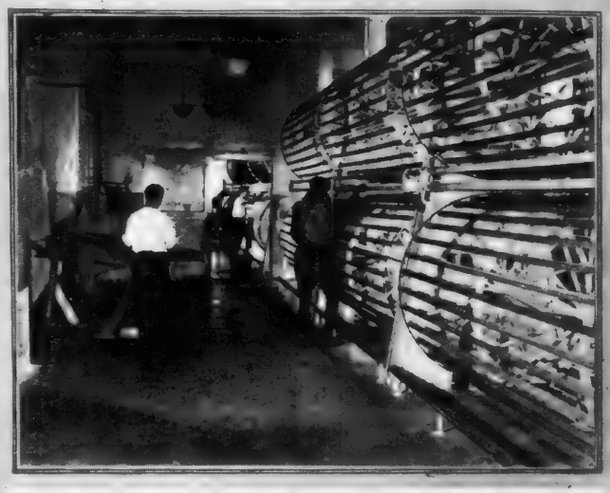
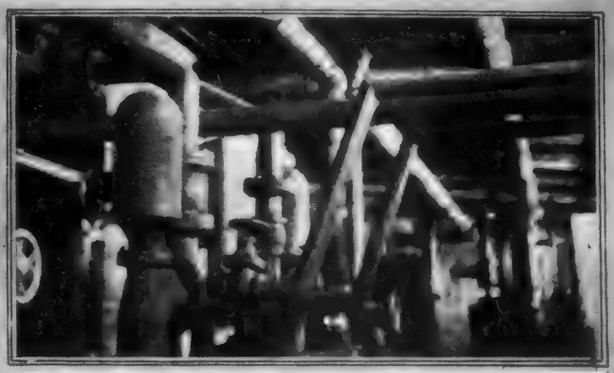
Fig. 1—Steps for Determining Different Characteristics of Air When the Wet and Dry-Bulb Temperatures are Known.

Engineering Pr



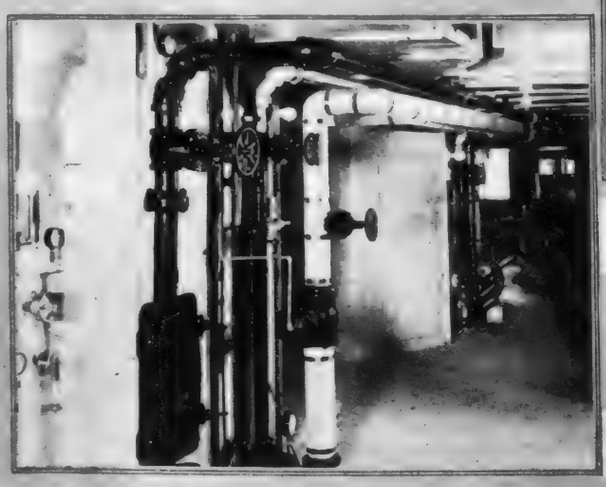
Film drying rooms in Paramount's new film laboratory in Hollywood. After being washed and dyed the film is wound on these huge drums.



Oxy-acetylene welded piping in an engine room.

Difficulties encountered in underground pipe conduit construction in St. Louis, Mo.

All-welded 10-in. high pressure steam line. Vitrified clay pipe culvert serves as insulation and protection against corrosion.



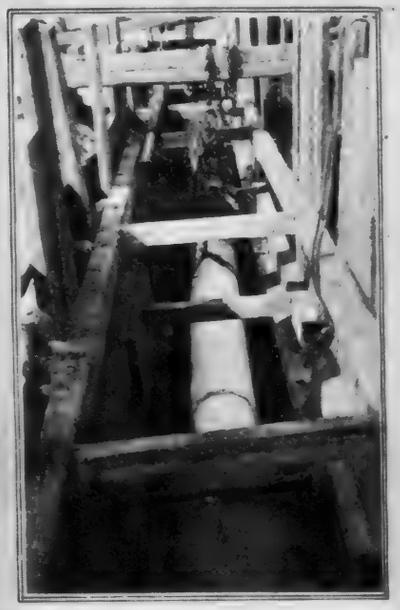
Part of the air-conditioning plant of Paramount's new film laboratory in Hollywood.

F. A. Combe, ... been appoi... governmen... tion heati... Fuel Boar...

ress Illustrated

What is sometimes found under the streets—an underground pipe installation in St. Louis, Mo.

Installing of 10-in. high-pressure line in Springfield, Mo., illustrating shoring methods, concrete base and covering.



Unusual bracing required for laying steam mains in trench in Bristol, Conn.

This is not a stove pipe but welded angles of a 22-in. main, with drip, in Grand Rapids, Mich.

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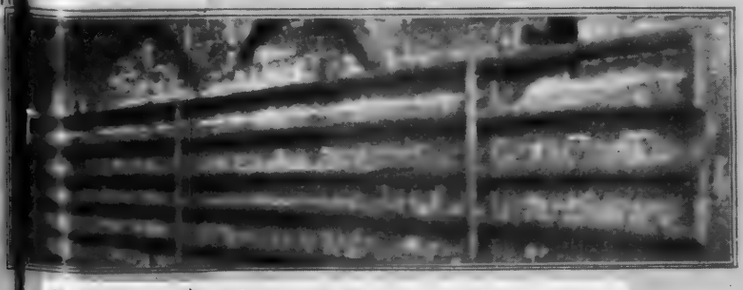
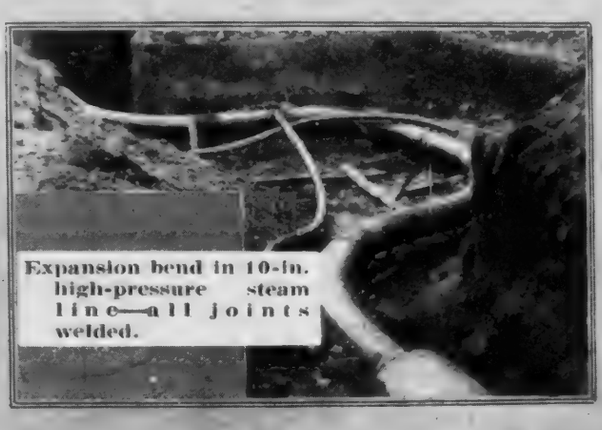


Radiator coils fabricated by oxy-acetylene process.



Expansion bend in 10-in. high-pressure steam line—all joints welded.

How To Use A Psychrometric Chart

Continued from page 65

PROCEDURE FOR DETERMINING CHARACTERISTICS OF AIR

With the two temperatures given, 71° wet-bulb, and 90° dry-bulb, Mr. Murphy then proceeded to show by reference to the psychrometric chart (Fig. 1) how all the other characteristics of the surrounding air can be learned. First, by putting a pencil on the intersection of these two temperatures at (1), it can be found that the air is 40% saturated with water vapor.

To obtain the actual weight of water vapor present per pound of air, we go over from 90° saturated at (2) to the column giving grains per pound and it will be found that 216.4 grains at (3), the air being 40% saturated, contains 40% of this amount, or 86.56 grains.

If it is desirable to know what the air weighs so that energies may be calculated, transferring the saturation point of the 90° dry-bulb at (6) to cubic feet per pound, shows 14.54 cu. ft. per pound at (7). Transferring the 90° dry air at (4) to the calibration at (5), the result is 13.85, giving a difference of 0.685 cu. ft. As the air is 40% saturated, 40% of this difference, or 0.274, added to 13.85 cu. ft., gives 14.12 cu. ft. per pound, under the conditions assumed.

WHY A FALLING BAROMETER INDICATES A COMING STORM

It is interesting to note, comments Mr. Murphy, that contrary to the average opinion, saturated air is lighter than dry air and that the moisture subtracts, rather than adds to the weight of the mixture; hence the falling barometer is an indication of a coming storm.

If this air is to be dehumidified, the energy contained per pound would be important, as it would be necessary to calculate the refrigeration required for subtracting the energy from the mixture. Transferring the wet-bulb temperature at 71° saturated, at (8), to the total heat above zero, at (9), and over to the calibration column at the left, gives 34.3 B. T. U. per pound, at (10).

To refrigerate this mixture to, say, 60°, 8.3 B. T. U. must be removed. So, dehumidifying becomes a simple proposition, particularly when it is realized that the wet-bulb of the mixture indicates the total energy and could be so calibrated on the observation or recording instruments.

The vapor pressure is frequently important, as mentioned before, and is solely the junction of the dew-point and bears no relation to either the dry or the wet-bulb. In this case, follow across to the dew-point and find 62½° at (11). Thence up to the vapor pressure curve at (12) and over to the calibrated column which indicates 0.57 in. of mercury, at (13).

Interest in this is due to the fact that if this air meets a hygroscopic material of a less vapor pressure, the material will gain weight from the equalizing of pressures and absorption of moisture and give off heat until equalization is reached. Or if the material is of a greater vapor pressure, it will lose weight by drying out and be cooled.

Knowing this factor it is easy to make material dry or regain moisture at will and is very useful in many industries, particularly in textiles. From this it will be noted that the psychrometric chart is really useful in solving any kind of an air conditioning problem that may present itself, and is the key or alphabet, to the language of manufactured weather.

OPERATIONS OF A HUMIDIFYING SYSTEM DURING BOTH SUMMER AND WINTER

Mr. Murphy then showed how to obtain the necessary information from the chart in connection with the operations of a humidifying system during both summer and winter in an industrial plant. Assuming that silk is being fabricated and that it is desired to maintain 11% regain in the material throughout the process, as it is best fabricated with this moisture content. Therefore, 70% humidity throughout the year is selected, as regain is more

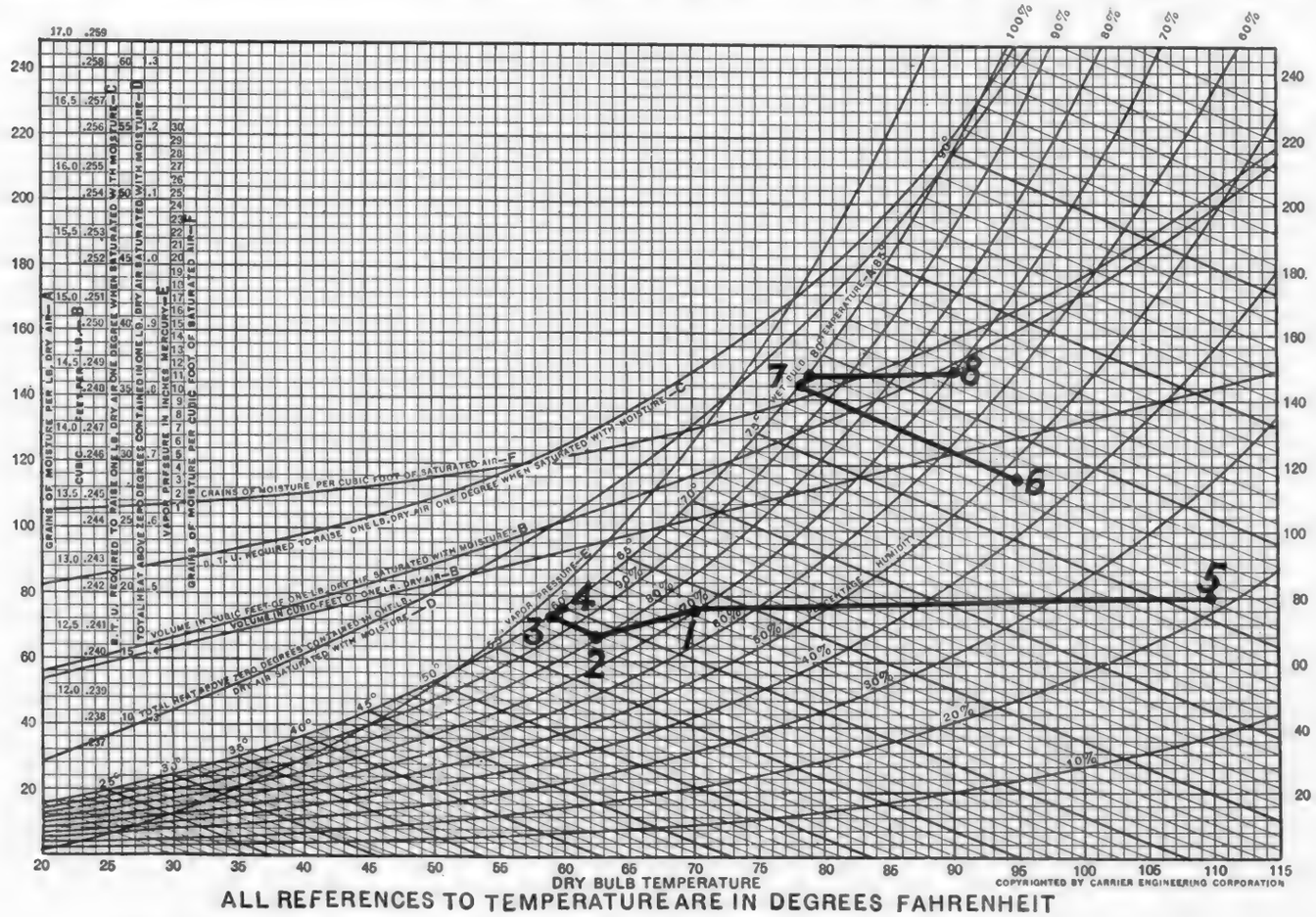

DRY BULB TEMPERATURE
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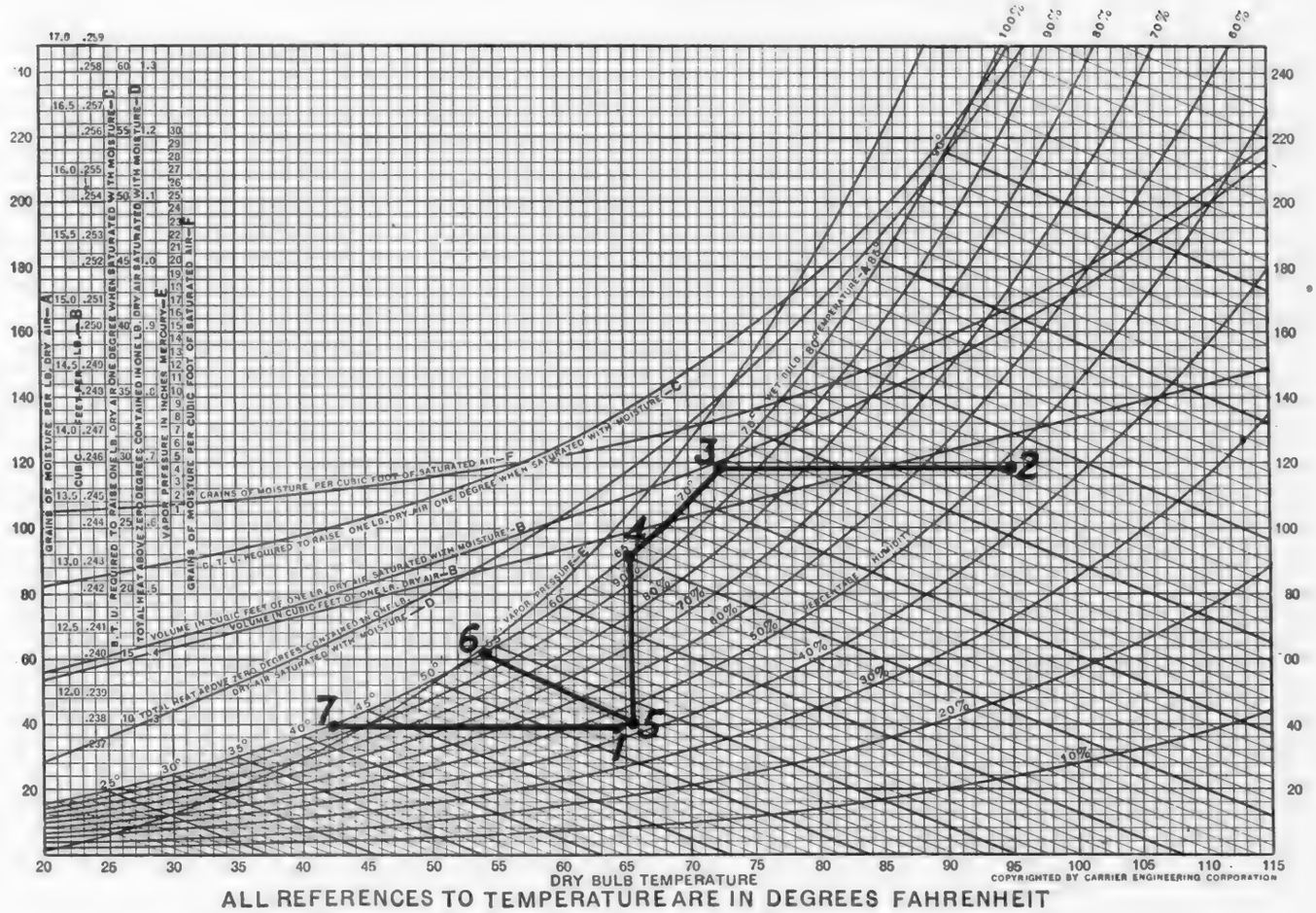
Fig. 2—How to Obtain the Necessary Information in Connection With a Humidifying System for an Industrial Plant.


DRY BULB TEMPERATURE
GRAINS OF MOISTURE PER LB. DRY AIR—A
GRAINS OF MOISTURE PER CUBIC FOOT OF SATURATED AIR—F
B.T.U. REQUIRED TO RAISE ONE LB. DRY AIR ONE DEGREE WHEN SATURATED WITH MOISTURE—B
VOLUME IN CUBIC FEET OF ONE LB. DRY AIR—D
VOLUME IN CUBIC FEET OF ONE LB. DRY AIR SATURATED WITH MOISTURE—C
TOTAL HEAT ABOVE ZERO DEGREES CONTAINED IN ONE LB. DRY AIR SATURATED WITH MOISTURE—E
VAPOR PRESSURE IN INCHES MERCURY—E
CUBIC FEET PER LB.
RELATIVE HUMIDITY
1
2
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5
6
7
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Fig. 3—Method Followed in Working Out Dehumidifying Problem in Candy Factory Packing Room.

nearly in accord with the relative humidity than any other single factor that is commercial to standardize.

Assume that it is zero outside, and that 1,000 lbs. of air are required per minute to heat the building to 70° F. and maintain 70% humidity. Also assume that there is infiltration into this building of outside unconditioned air of 10% the amount in circulation.

Referring to Fig. 2, the zero air contains only 5.7 grains per pound, while the 90% return air contains 77 grains per pound. Therefore, when the 70° air meets the 10% zero air in the mixing chamber, by traveling along the point (1) to (2), it is found that the mixture has a 62½° dry-bulb, 59° wet-bulb, and 57° dew-point.

It is an interesting fact that in this mixture, some condensation takes place in this assumed instance—the absolute humidity being reduced from 77 grains per pound to 69.3 per pound, or something over 1 lb. of moisture per minute, which would indicate that drains are desirable in the fresh-air intakes.

The air then comes in contact with the sprays and the instantaneous action is to cool the wet-bulb to 59°, or to the point of (3). It is then raised by the heat added to the water to the 60°, at (4), requiring, in this case, the addition of 1800 heat units per minute, where it arrives at point (4). Thence through the heaters to some point, such as (5), in order to heat the room.

On entering the room, it is cooled by transmission from the building back to 70°, without either the addition or subtraction of moisture and it arrives at the desired temperature and humidity at 70° and 70%.

In many mills moisture is absorbed by the stock or by infiltration, thus lowering the dew-point previously observed at the apparatus. This is usually compensated for by an auxiliary steam jet in the air distribution, after passing the heaters.

The summer cycle is very much simpler, as all fresh air is used. Assume that it is 95° outside with a 78° wet-bulb, which is about the maximum in this vicinity. This would start at a point marked (6) where the air comes in contact with the water sprays and is cooled along the wet-bulb line to 78° at saturation at point (7).

No energy is added or subtracted in this process but sensible heat is converted into latent heat. The air enters the room at the point marked (7) in sufficient quantity to absorb all of the internal heat of the plant, such as power, people, sunlight, radiation and transmission and rises to the point marked (8), or 89°, where it reaches the 70% curve. The mill, in this case, is 6° cooler than outdoors, without any expense of operation beyond that of moving the air and pumping the water.

This phenomenon of evaporative cooling is probably one of the most valuable applications that have been made to the equipment of a textile mill since it makes possible and convenient the placing of a cotton mill in a cotton field and the production of fine yarns under livable conditions.

DIFFERENT LAWS APPLY TO DEHUMIDIFYING

While the appearance of a humidifier and a dehumidifier are somewhat similar, their action does not depend upon the same laws. A humidifier is a cooling device only because of the evaporative characteristics of water. There is no change in energy or actual work done, with the exception that some of the sensible heat of the air and water vapor mixture is converted into latent heat.

Water is in no way valuable in a dehumidifier, except that it is an easily obtainable, cheap medium for presenting cold contact surface with the air to be cooled and the water vapor to be condensed.

To follow this latter action on the chart (Fig. 3), assume that the problem in hand is a packing room in a candy factory, with a room temperature of 65 F. and 45% relative humidity is desired, that a spray-type of humidifier is to be used and that the day outside is 95 F. dry-bulb and 78 F. wet-bulb. Further that 1000 lbs. of air per minute are required to do the work of which 95% is in constant recirculation, augmented by 5% outside air at the apparatus for ventilation.

The air returns from the room at 65° dry-bulb, and 52½° wet-bulb, which has been designated on the chart as point (1). Five per cent fresh air enters at the point marked (2) in the fresh and return-air mixing chamber, and is first cooled by contact with the 65° air to point (3), or 71½°. This is on the saturation curve and by cooling to point (4), that is, 66°, con-

densation takes place. From point (4) to point (5) the relative humidity of this fresh air is further reduced by dilution in combining with the return air. In the meantime the return air has been raised from 65° dry-bulb to 66° approximately, and from 52½° wet-bulb to 54° wet-bulb approximately at (5).

At point (5) the air enters the dehumidifier and is probably instantaneously cooled by evaporation to point (6). No useful work having as yet been done. From point (5) to point (7) there is an actual absorption of energy reducing the air to its desired dew-point of 42°. Here not only is the temperature reduced, but condensation takes place.

At point (7) the air enters the room and absorbs heat due to the process, power, infiltration, radiation, etc., and reaches its destination at the desired temperature of 65° and 45% humidity. The cycle is then repeated.

It is interesting to note, concludes Mr. Murphy, that in the fresh-air intake, in this assumed instance, 4½ tons of work are transferred from the return air to the fresh air which will account for the usual difficulty in obtaining a thorough mixture. Also, that in this action some 12¼ lbs. of water per hour are condensed, which will readily show the necessity for water tight or insulated fresh-air intakes for dehumidifiers.

All of the useful work was done between points (6) and (7), which by reference to the total heat curve before mentioned, would show that 6 1/10 B. T. U. had been removed per pound of air, or 30½ tons of refrigation for the 1000 lbs. of air.

Practice of the Treasury Department in Corridor Venting.

In view of the advocacy in many quarters of corridor venting, considerable interest attaches to the latest practice of the Office of the Supervising Architect, Treasury Department, as outlined by Nelson S. Thompson, chief engineer.

"This method," he states, "appears to me to be very practicable and efficient, and in my recent schoolhouse work I have recommended it exclusively.

"The latest scheme I have adopted is to install the lockers in the corridors, and, on the inside wall of the school room against which the lockers abut, to install in the baseboard long narrow grilles or registers of the required area, connecting these by proper openings with the base of the lockers. The lockers are constructed with a wire-mesh grille just above the level of the vent opening from the school room, and the tops of the lockers are protected with another stout wire-mesh grille, the idea being that all the air exhausted from the school room shall pass out through the lockers and into the corridor.

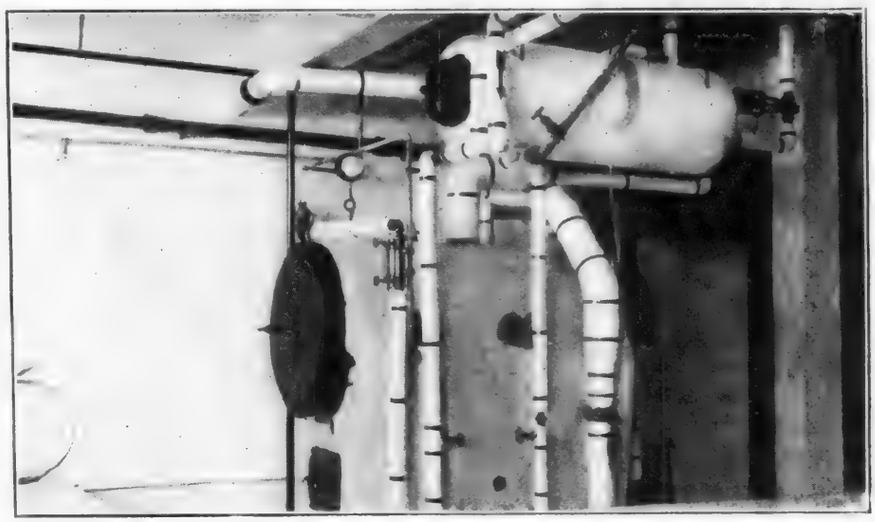
"The corridor is vented into a shaft, preferably, in small school houses, containing the metal smokestack of the heating apparatus, or is connected to a fan with outboard discharge.

"This eliminates the usual individual and costly vent ducts and I am convinced, will give good results."

Heating and Aerating Water for San Francisco Aquarium.

An aquarium has recently been placed in operation in Golden Gate Park and has been equipped with a heating plant for heating water for certain species of tropical fish. Steam coils are installed in a storage tank placed over the exhibition tanks. The water is thus heated to the proper temperature and held there by a thermostat.

The cycle of operation is as follows: Water in the storage tank after being heated flows by gravity to a distributing main above the warm-water fish exhibition tanks, to which it is distributed by adjustable nozzles feeding the water through glass tubes, at the same time drawing in air, on the injector principle, to aerate the water.



Water Heating Equipment for San Francisco Aquarium.

From the fish exhibition tanks the warm water overflows to a collecting main, and is carried thence to a sand filter in the engine room. After passing through the filter it flows to a sump under the filter and is pumped by a centrifugal pump back to the overhead heating tank. This pump, similar to three other pumps, is controlled automatically by a float switch in the warm-water storage tank, the float being set to operate on a difference of 1 ft. in the water level.

Fuel-Oil Cost Data.

A timely compilation of fuel-oil cost data has been made by Leod D. Becker and is given in an article published by him in *Fuel-Oil* for November, 1923. The combustion of 1 lb. of oil, he states, will yield about 18,000 B.T.U. If oil weighs 7 lbs. a gallon, its heat energy would be about 125,000 B.T.U. per gallon.

The amount of heat which can be produced by the complete combustion of 1 lb. of coal ranges from over 14,000 B.T.U. for the higher grades, to below 10,000 B.T.U. for the lower grades. In the calculations he gives, he assumes that coal as sold for domestic heating has a heat emission of 12,500 B.T.U. per pound. 1 gal. of oil, therefore, has about the same heat content as 10 lbs. of fairly good coal.

In the accompanying table the cost of 1,000,000 B.T.U., or, rather the cost of 8 gal. of oil, is compared with the cost of 80 lbs. of coal, each of which, if completely burned, would yield, according to Mr. Becker's estimate, 1,000,000 B.T.U. He points out that coal, however, is never burned completely, while the losses due to incomplete combustion of oil are probably very small in a good installation. A good oil-burner, he states, will permit close temperature regulation, hence oil heat is also much less wasteful than coal heat.

He concludes that it is probably fair to assume that 40% of the heat of combustion of coal is used, while with oil 60% of the heat of combustion is used in house heating. That would mean that oil is used one and one-half times more efficiently than coal. If this is true, the cost per 1,000,000 B.T.U. actually used would be as shown on the accompanying table.

Cost of Oil Cents Per Gallon	Cost per Million B.T.U.	Cost of Coal Per short ton	Per long ton	Cost per Million B.T.U.
5	$0.67	$ 5.00	$ 5.60	$ .50
6	.80	6.00	6.70	.60
8	1.07	8.00	8.95	.80
10	1.34	10.00	11.20	1.00
12	1.60	12.00	13.40	1.20
13	2.00	15.00	16.80	1.50

Mr. Becker supplements his table with some cost data on gas, stating that the calorific value of gas is 500 B.T.U. or less per 1,000 cu. ft. Hence gas at $1.00 per 1,000 cu. ft. is the equivalent of oil at 25 cents a gallon, or gas at 50 cents per 1,000 cu. ft. is equivalent to oil at 12½ cents a gallon.

Building Equipment Opportunities on the Pacific Coast

According to the National Bank of Commerce of New York, the next fifty years are going to transform the stretch of country from Seattle to San Diego into an industrial region similar to the Atlantic Coast from Portland to Baltimore. In an article in the December issue of its publication, *Commerce Monthly*, it is stated that sufficient hydroelectric energy for all probably industrial demands is at least in sight, if not yet developed.

American Society of Heating and Ventilating Engineers

Program for Annual Meeting.

According to the program for the annual meeting of the American Society of Heating and Ventilating Engineers, at the Hotel Pennsylvania, January 22-25, the first day will be devoted to routine business and the presentation of professional papers. The second day, Wednesday, the 23rd, will be Research Laboratory day.

Thursday, the 24th, will be Code Session day when the extensive work of the Committee on Code of Heating and Ventilating, with its fifteen sub-committees, will present its report through Chairman L. A. Harding. As is well-known, this report has engaged the attention of the society during the past year and is considered one of the most important projects the society has ever undertaken. The various sub-committees and their chairmen are as follows:

1. Definition of Terms, F. Paul Anderson.
2. Ventilation Requirements for Public Buildings, E. Vernon Hill.
3. Determining Outside Temperatures, F. R. Still.
4. Requirements for Heating Buildings, A. C. Willard.
5. Direct Steam or Hot Water Radiation, R. V. Frost.
6. Indirect Steam or Hot Water Radiation, L. C. Soule.
7. Heating Boiler Capacity, J. F. McIntire.
8. Warm-Air Furnace Heating, J. D. Hoffman.
9. Design of Chimneys and Flues, J. R. McColl.
10. Pipe Sizes for Steam Heating, J. A. Donnelly.
11. Pipe Sizes for Water Heating, W. S. Timmis.
12. Air Ducts for Ventilation, C. A. Booth.
13. Air Washers and Humidifiers, W. H. Carrier.
14. Pumps for Heating Systems, Perry West.
15. Standard Symbols for Drawings, J. H. Walker.

The tentative program in detail is as follows:

Tuesday, 10 a.m.: Business session.

Tuesday, 2 p. m.: "Ventilation of Department Stores," by A. M. Feldman; "Dust Separation," by A. M. Goodloe; "Air Handling in Coated Paper Mill," by Arthur North; "Electric Heating," by L. P. Haynes.

Wednesday, 10 a. m.: "An Improved Method of Determining the Heat Transfer Through Wall, Floor and Roof Sections," by Norris, Germond and Tuttle; "Economical Utilization of Central Heat Station," by N. W. Calvert and J. E. Seiter; Heat Emission from Heating Surfaces of Circular Radiator Furnace," by A. P. Kratz; "The Status of Domestic Oil Heating," by A. M. Ballard.

Wednesday, 2 p. m. (Research Session): Report of Research Committee; "Research and Industrial Progress," by F. Paul Anderson, Director; "Measurement of Heat Transmission in Building Structures and a Heat Transmission Meter," by P. Nicholls; "Critical Velocity of Steam and Condensate Mixtures in Horizontal, Vertical and Inclined Pipes," by Louis Ebin, F. C. Houghten and R. L. Lincoln; "Checking Up the Kutter Formula and Its Application to the Flow of Liquids and Gases Through Small Pipes," by L. S. O'Bannon.

Wednesday, 8 p. m. (Research Session): "Air Motion, High Temperatures and Various Humidities Affecting Physiological Reactions of Human Beings," by Dr. W. J. McConnell, C. P. Yagloglou and F. C. Houghten; "Cooling Effect on Human Beings Produced by Variable Air Velocities," by F. C. Houghten and C. P. Yagloglou; "Air Leakage Through the Openings in Buildings," by F. C. Houghten and C. C. Schrader; "The Production and Measurement of Air Dustiness," by Margaret Ingels.

Thursday, 10 a.m. and 2 p.m.: Discussions of proposed code of heating and ventilating.

Friday, 10 a.m.: Report of Committee to Consider the Report of the New York State Commission on Ventilation.

An entertainment program has been arranged by a general committee headed by George G. Schmidt, of the Carrier Engineering Corporation. The sub-committee chairmen are: Finance, William J. Olvany; Entertainment, Alfred Engle; Ladies, Miss Helen R. Innis; Meetings, H. P. Kahn; registration, Arthur Ritter.

Philadelphia Chapter Hears Talks on Smokeless Combustion.

The merits of the down-draft and up-draft boilers for the smokeless combustion of bituminous were discussed at the November meeting of the Philadelphia Chapter, the down-draft principle being presented by W. G. Culbert and H. B. Hedges, and the up-draft principle, as applied to the carburetor type of furnace, being described by E. F. Glore and C. F. Fuller.

Professor A. C. Willard Guest of St. Louis Chapter.

Professor A. C. Willard, head of the department of mechanical engineering, University of Illinois, was the guest of the St. Louis Chapter at its November meeting. He told of the research work on warm-air furnaces and equipment being conducted at the university.

Nominations of officers of the chapter were announced as follows: President, W. A. Klein; for first vice-president, A. M. Lane: for second vice-president, J. D. Falvey; for treasurer, E. H. Quentin; for secretary, Thomas J. C. Gale; for board of governors: E. S. Hallet, E. P. Bradley, E. R. Graves and E. A. White.

Semi-Dry Filters Discussed by Kansas City Chapter.

C. H. Carr, president of the C. H. Carr Machinery Company, was the principle speaker at the December meeting of the Kansas City Chapter, his subject being "Semi-Dry Filters." Mr. Carr pointed out the wide application of these devices for cleaning air for use in ventilation.

The meeting was held December 3, at the Kansas City Club, and was attended by 22 members and guests. President W. E. Gillham presided.

B. F. Cook reported on the recent meeting called by the Health Conservation League in the interest of the Kansas City General Hospital. Arrangements are being made for the construction of a nurses' home, a power plant, and additions to the hospital. The meeting was for the purpose of formulating public opinion favorable to these projects and the Kansas City Chapter, as a member of the Round Table of Club Presidents, has been urged to assist in every way possible.

Charles Herold was elected to membership in the chapter.

Motion Pictures of the Hudson River Vehicular Tunnel Shown at Meeting of Wisconsin Chapter.

Professor A. C. Willard, of the University of Illiniois, was the principle speaker at the December meeting of the Wisconsin Chapter, held at the Plankinton Hotel, Milwaukee, December 4. Professor Willard gave an innteresting talk on the problems and work connected with the Hudson River vehicular tunnel. Many of these problems were solved at the Engineering Experiment Station of the University of Illinois, as described in THE HEATING AND VENTILATING MAGAZINE for May, 1922) Professor Willard's address was illustrated with motion pictures of the installation.

New York Chapter's "Past President's Night."

A novelty in the way of an association meeting was carried out by the New York Chapter, at its December meeting in the Building Trades Club, December 17, when the past presidents of the chapter were lined up at the head table for the inspection of the gathering and later called on to "start something." The past-presidents present, in the order of their service, were Frank G. McCann (1912-13), Walter S. Timmis (1914-15), William H. Driscoll (1915-16), Arthur Ritter (1916-17), P. H. Seward (1918-19), Perry West (1919-20), W. L. Fleisher (1920-21), A. S. Armagnac (1921-22) and W. H. Carrier (1922-23). The first president of the chapter, in 1911-12, was the late W. M. Mackay. Thus all of the living past-presidents were on hand, with the exception of Dwight D. Kimball (1913-13) and Frank K. Chew (1917-18), who was too ill to be present.

In presenting the speakers, Chairman A. S. Armagnac stated that each one had been asked to select his own subject provided only that he "started something." Mr. McCann led off at once with a query as to whether the heating and ventilating industry was agreeable to the installation of elaborate apparatus unless some better provision existed that that now in effect for its proper operation.

Walter S. Timmis startled his hearers with a proposal that the heating industry add plumbing to its field of operations. He also proposed that inasmuch as heating systems are seldom called upon for their full capacity some means be found for accelerating such systems so as to permit those

of smaller capacity being installed. He concluded by suggesting a Christmas memento from the chapter for Frank K. Chew, who is still seriously ill. This suggestion struck a responsive chord and the members and guests present, numbering nearly 100, all participated in the gift.

William H. Driscoll "started something" by questioning the usefulness of the fuel-oil burner designs of the household types as developed to date. He thought considerable more development work was necessary before fuel-oil for house heating could be undertaken with success. Speaking of the A. S. H. & V. Research Laboratory, he recommended that the laboratory establish minimum standards for the performance of apparatus and appliances and stamp such apparatus with its stamp of approval as meeting the minimum requirements set.

Arthur Ritter told of the early days of the chapter and contrasted its struggles with its present success both in numbers and in interest.

P. H. Seward talked on boiler ratings, reviewing the previous discussions of the subject and he urged the industry to "finish something" in this regard rather than to "start something." Too many things, he said, are started, and too few are finished.

Perry West discussed research work, taking the ground that what was needed now in ventilating work was not much the fundamental requirements as the best means for carrying out those requirements.

W. L. Fleisher told of the work of the Standardization Committee of the Heating and Piping Contractor's National Association, of which he is chairman, and stated that the committee is now at work compiling a code on the care and selection of boilers.

W. H. Carrier discussed some of the points brought out by the previous speakers, especially those of Mr. West and emphasized the importance of getting down to fundamentals so that it would be possible to make clear the nature of the problems to be solved.

Discussing Mr. Seward's remarks, Homer Addams stated that many of Mr. Steward's hopes would be realized in a report to be presented at the annual meeting of the heating engineers' society.

Announcement was made of the appointment of a general entertainment committee of the chapter, headed by George G. Schmidt, to take care of the entertainment features of the annual meeting of the society, at the Hotel Pennsylvania, New York, January 22-25.

Massachusetts Chapter

Members of the Plant Engineers' Club and of the Boston section of the American Society of Mechanical Engineers were guests of the Massachusetts Chapter of The American Society of Heating and Ventilating Engineers at a meeting held recently in Tremont Temple, Boston. A. H. Ballard of the Ballard Oil Burning Equipment Co., and M. M. Osborne of the Petroleum Heat & Power Co., were the chief speakers on the program.

National Survey of Country's Apprenticeship Needs

The Apprenticeship Committee of the American Construction Council has undertaken a national survey of the country's apprenticeship needs and of the instructional facilities and standards for apprentice training in the construction crafts.

The decision to proceed with this essential step in coping with Secretary of Commerce Hoover has pronounced "one of the most difficult problems that faces the country today" was reached at a meeting of the committee in Buffalo, N. Y. recently.

John Donlin, president of the Building Trades Department of the American Federation of Labor, who suggested the survey, was named chairman of the committee on survey of apprenticeship needs and the distribution of labor. C. A. Presser, director of Dunwoody Institute, Minneapolis, Minn., will head the committee on instructional facilities and standards. The committee on finance will be headed by John W. Cowper, president of the Associated General Contractors of America, Buffalo, N. Y.

Research Bulletin No. 1 of the (British) Institution of Heating and Ventilating Engineers.

A "Report of Research on the Effect of the Shape and Surroundings of a Hot Surface on the Radiation from It," constituting Bulletin No. 1 of a series undertaken by the Research Committee of the (British) Institution of Heating and Ventilating Engineers, has been published under the authorship of Arthur H. Barker, director of laboratory, and M. Kinoshita, assistant. The tests described were made at University College, London, with the aid of grants from the Department of Scientific and Industrial Research. The research was completed in July, 1917, but publication has been delayed until now, due to the war and, later, to its after-effects.

A large part of the present bulletin deals with the mathematical theory of the mutual interchange of heat between two surfaces at different parts of one surface, each of which is emitting radiant energy, some portion of which impinges on the other surface. The intricacy of the subject is illustrated in the involved calculations found necessary for a complete exposition of the matter. As a scientific treatise the bulletin constitutes a valuable addition to our knowledge of radiant heat and the generosity of the British heating fraternity must be recognized in making possible such a research which, by its nature, can be of only limited direct benefit to themselves in a practical way. However, a number of examples are considered dealing with heat emission from radiators and the point is made in connection with cast-iron sectional radiators that a radiator of high efficiency must be so designed as to lose as little heat as possible by mutual radiation, that is, from one section to another. While precise analysis of the heat transmission from radiators, it is stated, requires further investigation, it is safe to assume that the radiated heat from ordinary radiators is approximately 10% of the total transmission.

The Appendix, accompanying the report, includes a description of the experiments themselves, one test being made to determine the distribution of the intensity of heat radiation in front of a heated square; one to determine the distribution of the intensity of heat radiation in front of an infinite cylinder and a sphere; one to determine the apparent emissivity; and one to determine the oblique radiation. Views of the testing equipment are included. Size 8½ x 11 in. Pp. 68.

Oil for House Heating as Seen by the American Oil Producers' Association.

A meeting of unusual interest to the heating fraternity was held in St. Louis December 11-13 when the members of the American Oil Producers' Association met for a three-day convention, with oil for house-heating as the keynote of the meeting. In addition to the 450 delegates present, many oil burner manufacturers and engineers were in attendance.

President Henry L. Doherty, in his address, expressed the belief that more money has been spent during the past year by manufacturers on the development of house-heating oil burners than for all such purposes by the oil industry in the sixty-odd years of its existence. He recommended as a program for the industry:

(1) That we make such changes in the basic methods of producing crude oil that the raw product will be located in vast quantities, and checked out in large amounts, so as to be readily accessible, and under conditions where it will not have to be forced upon the market in excess of what the market can absorb.

(2) That we stimulate every oil company to develop all possible demonstrated applications for the utilization of oil.

(3) That we give support, encouragement and assistance to inventors and manufacturers of all oil-burning apparatus.

The general opinion was expresssed at the convention that the keynote of the future success of the oil burner industry, particularly in connection with house-heating, was the classification and standardization of the various types of burners and equipment, into some such classification as atomizing burners, gravity burners, straight-shot burners, etc. It was stated that the United States Bureau of Mines has agreed with the Oil Burner Manufacturers' Association to standardize the specifications of fuel-oil for different kinds of burners.

Among the other speakers at the convention was Homer R. Linn, engineer for the American Radiator Company, who urged co-operation between the Oil Burner Manufacturers' Association and the heating fraternity.

It was brought out that while four years ago approximately 3% of the oil burners installed were new installations, today the number has increased to something like 16% to 17%. It was predicted that the next four years will see an even greater growth of the industry.

Some lively discussions arose over the efficiency of the present types of burners for household use and it was felt by many that the oil burner inventor's first consideration should be the safety of the burner.

Curtis R. Welborn, of the Underwriters' Laboratories, in his address, spoke particularly of the regulations for oil-burning equipment published by the National Board of Fire Underwriters, as recommended by the National Fire Protection Association, copies, of which, he stated, could be obtained free of charge. (These regulations were published in abstract in THE HEATING AND VENTILATING MAGAZINE for January, 1923).

Research and Educational Plans of the Furnace Manufacturers

Decision to build an educational research residence at a cost of $25,000, and the consideration of plans to extend materially the association's research and educational publicity programs, were outstanding features of the mid-year meeting of the National Warm-Air Heating and Ventilating Association, which was held in Urbana, Ill., December 4. Although the sessions were at the Urbana-Lincoln Hotel, the whole party visited the headquarters of the association's Research Bureau, in the Engineering Experiment Station of the University of Illinois. Many of those present saw for the first time the experimental apparatus and the scope of the work being done in warm-air furnace research, under the direction of Professors A. C. Willard, A. P. Kratz and S. V. Day.

Members of the association believe the organization took a long step forward through its adoption of the resolution to build a house in which to further its educational research work. This recommendation was presented by I. L. Jones, chairman of the Joint Committee of the Research, Advisory, Executive and Code Committees, of the association.

"After careful consideration," stated the report, "such a house is practical, advisable and necessary for the purpose intended." The report therefore recommended that the executive committee be authorized to proceed with the purchase of the real estate and the erection of such a house at a cost not exceeding $25,000. The type and size of house had already been determined. It was further provided that the necessary funds be raised through an assessment, based upon the unit plan, as provided by the association's constitution, and that the assessment should be at the rate of $10.00 per unit, payable 50% at once and the balance within six months, or on call.

Among those who spoke favorably on the proposition were I. L. Jones, Professor A. C. Willard, J. D. Hoffman, E. F. Glore, F. W. Phelps, R. W. Menk, W. H. Hill Joseph Farris and others.

The resolution was adopted unanimously and the following trustees appointed to take title to the Educational Research Residence: Professor A. C. Willard, Urbana, Ill.; Allen W. Williams, Columbus, O.; and Fred W. Phelps, Joliet, Ill.

REPORT OF PUBLICITY COMMITTEE.

The report of the Educational Publicity Committee, Dr. John P. Wagner, chairman, which was presented by E. F. Glore, recommended the expansion of the association's existing trade extension bureau and that it be known hereafter as the "Trade Extension Bureau of the National Warm-Air Heating and Ventilating Association." It was further recommended that the financing of the bureau be based upon some definite plan covering a period of three years, or preferably five years, and that the total amount to be raised for the three years' period should be not less than $150,000, and that the sum of $35,000 should be available for the use of the bureau in 1924. Funds were to be raised from among the member companies of the association, and pledges secured also from dealer members.

Attention was called to the success that had attended similar movements in other industries and the prediction was made that the establishment of a bureau with sufficiently wide scope would bring about a higher standard in the industry and extend the industry into fields in which warm-air furnace heating is scarcely known.

On motion of E. F. Glore it was voted to thank the committee for its work and to appoint a sub-committee to act with the existing committee and present a program at the next annuual meeting. Those named as members of this sub-committee are E. F. Glore, D. Rait Richardson and Roy C. Walker.

It is planned to establish headquarters of the enlarged bureau "in one of the large cities most centrally located" with a director or manager who shall be free from any active connection with the manufacture of or the distribution of products of the industry or competitive products, which rule shall also apply to all employees of the bureau.

Activities of the bureau were outlined as follows: 1 - Manufacturer (a) commercial research survey; (b) trade statistics; (c) 42—8351—Heating and Ventilating .. .. .. trade sales promotion; (d) competitive stimulation; (e) improvement of business ethics and marketing conditions; (f) standardization of products and methods; (g) educational advertising publicity.

2 - Dealer (a) educational propaganda promoting better merchandising and service; (b) proper display of merchandising and local advertising (c) competent sales methods (d) adherence to installation in accordance with furnace code.

3 - Consumer (a) educational propaganda dealing with advantages of warm-air heating and ventilating (b) how to select the proper heating plant (c) education in maintenance and care of warm-air heating plants (d) data on fuel values.

Determining the Sizes of Warm-Air Furnaces According to the Warm-Air Furnace Code.

A proposed method of determining the sizes of warm-air furnace, in accordance with the well-known installation code on this subject, was presented to the Western Warm Air Furnace & Supply Association, at its recent meeting in Chicago, by the retiring president, E. L. Jaynes.

After commenting upon the fact that it will be some time before anything definite on these lines may be expected from the Research Bureau, at the University of Illinois, President Jaynes suggested the following rule for use until a better one is worked out:

After determining the combined area of all the warm-air pipes, in accordance with the code, select a furnace having a grate the area of which will equal two-thirds of the area of the warm-air pipes in square inches. This rule, he stated, can be best illustrated by reversing the proposition and saying that a furnace having a grate area 18 in. in diameter would heat 381 sq. in. of warm-air pipe area; one having a 20-in. grate would heat 471 sq. in.; and a furnace having a 22-in. grate, 570 sq. in. of warm-air pipe area, and so on.

These figures, he said, were arrived at by taking the area of the grate in square inches and adding 50%. Further, they are based on heat losses as determined by the present code, and on returning the air to the furnace at 60° and delivering it to 195° at the register, and burning between 3 and 4 lbs. of coal per hour per square foot of grate area, when the thermometer is at zero outside.

Mr. Jayns said it was his belief that grate area is the proper basis for rating furnace capacities. Some furnaces, he added, will be more efficient than others, but the difference is not great and until each make of furnace is finally and thoroughly tested, there will always be much controversy and difference of opinion and prejudice. It is this controversy Mr. Jaynes would avoid by leaving out of the question entirely any reference to efficiency, and base the rating on the cold question of grate surface only.

A Practical Plan for Better Warm-Air Furnace Work.

Basing his recommendations upon a questionnaire sent out to 1,000 warm-air furnace dealers, F. E. Sedgwick, vice-president of the Waterman Waterbury Co., Minneapolis, Minn., speaking before the Western Warm Air Furnace & Supply Association, offered the following suggestions to promote better practice in furnace installation work:

"My suggestion is that those who really desire good furnace installations band themselves together under a descriptive name or title. This word must be copyrighted or trade-marked, or whatever is the proper thing to do to protect it from infringement, and no furnace manufacturer, jobber or dealer should be allowed to sell his furnaces under that distinctive name unless he subscribes to the conditions laid down by what we know to be proper installation methods. The basic features of such a scheme are admirably provided for by the National Trade Extension Bureau.

"The fundamentals of proper installation methods are in our hands already. They consist in part of the following:

"1. Figure every job. Figure according to the National Code (less the fire insurance underwriter's provisions if you wish).

"2. Choose a furnace easily large enough. The University of Illinois should have some information for us on this shortly, but until that time a rule-of-thumb method of rating furnaces can be devised that will meet the situation nicely.

"3. Insist on the use of the proper transition fittings on both warm-air pipes and cold-air returns, and of register boxes and faces of sufficient free area. (These items, I believe, are covered in the National Code).

"A group of a dozen manufacturers and jobbers, two dealers in one town, both talking for the same kind of installations, would mean a powerful improvement in the business, and it is my opinion the thing would grow through publicity in the trade papers and through the advertising that it would give to itself.

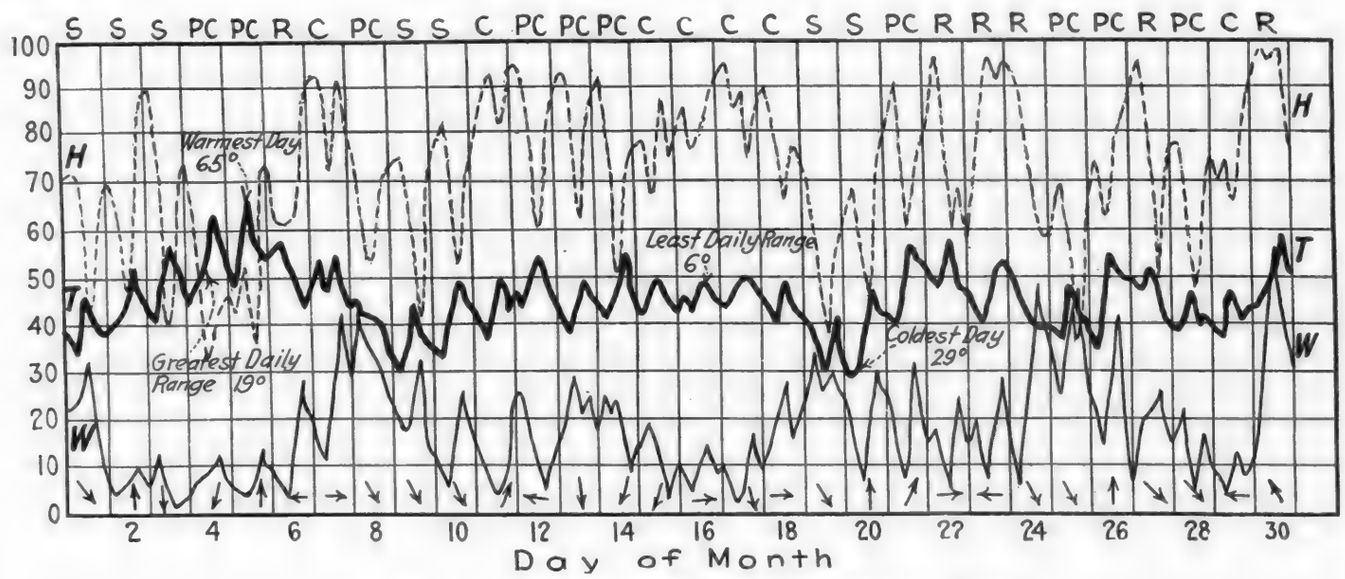
"Back up such a suggestion with a national advertising campaign.

"Let every furnace manufacturer, jobber or installer subscribe to certain terms (perhaps it might be well to incorporate a code of ethics) make him pay for the privilege of using this title or name; make him pay annually; revoke his license if he fails to live up to the terms of his agreement."

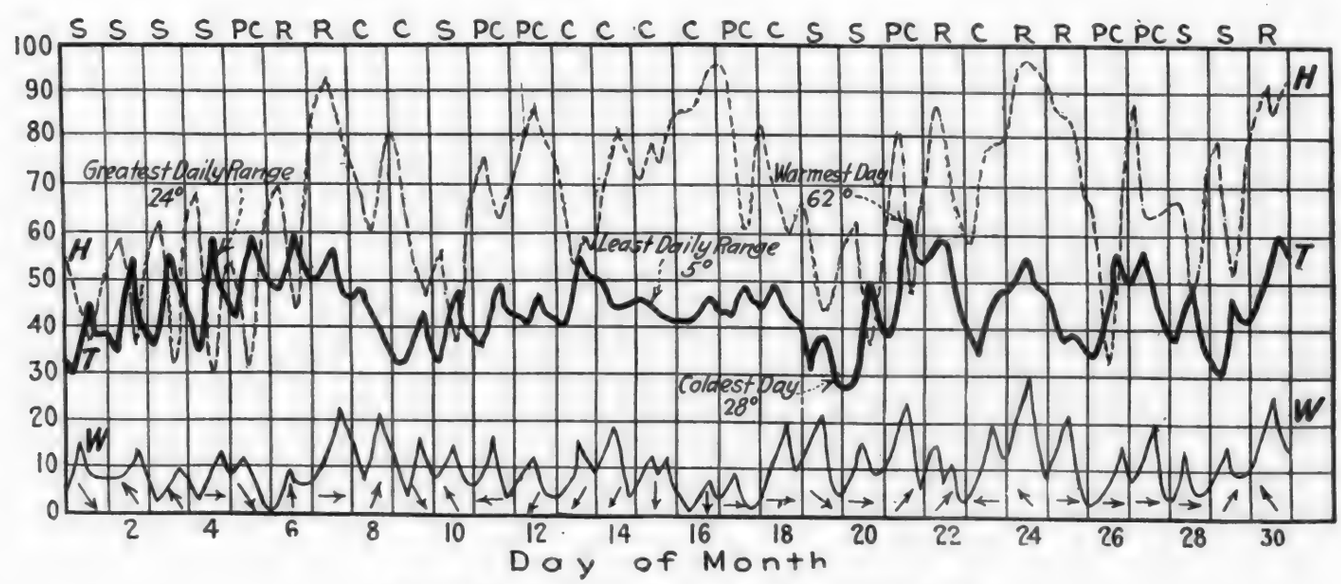
The Weather for November, 1923

	New York	Boston	Pittsburg	Chicago	St. Louis
Highest temperature, deg. F.	65	62	65	62	70
Date of same	5	21	21	10	10
Lowest temperature, deg. F.	29	28	29	31	30
Date of same	20	19	9	22	27
Greatest daily range, deg. F.	19	24	29	24	27
Date of same	4	4	14	10	10
Least daily range, deg. F.	6	5	4	4	2
Date of same	16	15	24	27	4
Mean temp. for month, deg. F.	45.4	44.6	43.2	43.8	47.9
Normal mean for month, deg. F.	44.2	42.0	43.2	41.2	45.1
Total precipitation, inches	2.26	2.78	2.39	1.46	1.90
Total snowfall, inches	0	T	0.2	T	T
Normal precip. for month, in.	3.44	4.10	2.55	2.50	2.88
Total wind for month, miles	11,379	6,526	7,909	8,354	8,580
Prevailing direction	N W	W	N W	N W	N W
Number of clear days	7	9	6	8	12
Number of partly cloudy days	12	8	8	5	7
Number of cloudy days	11	13	16	17	11
Number days with precipitation	7	7	11	7	6
Number of days with snow	0	0	1	0	0
Snow on ground at end of month, in.	0	0	0	0	0

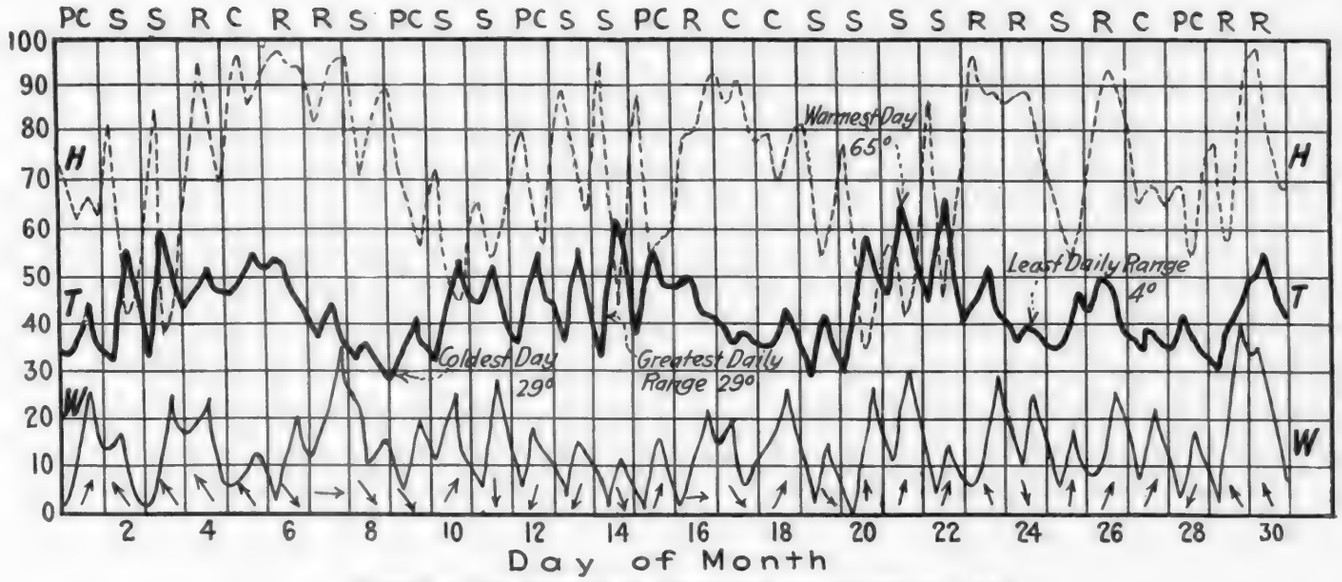
T=Trace



Record of the Weather in New York for November, 1923



Record of the Weather in Boston for November, 1923


PC S S R C R R S PC S S PC S S PC R C C S S S S R R S R C PC R R
Warmest Day 65°
Least Daily Range 4°
Coldest Day 29°
Greatest Daily Range 29°
H
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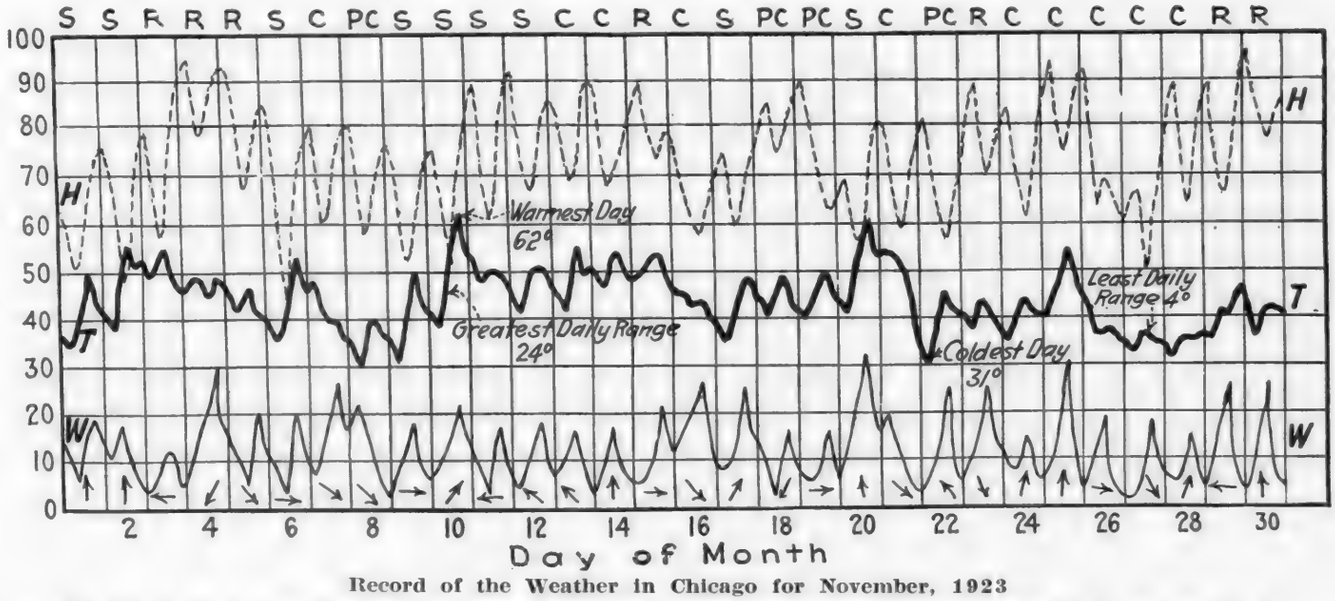
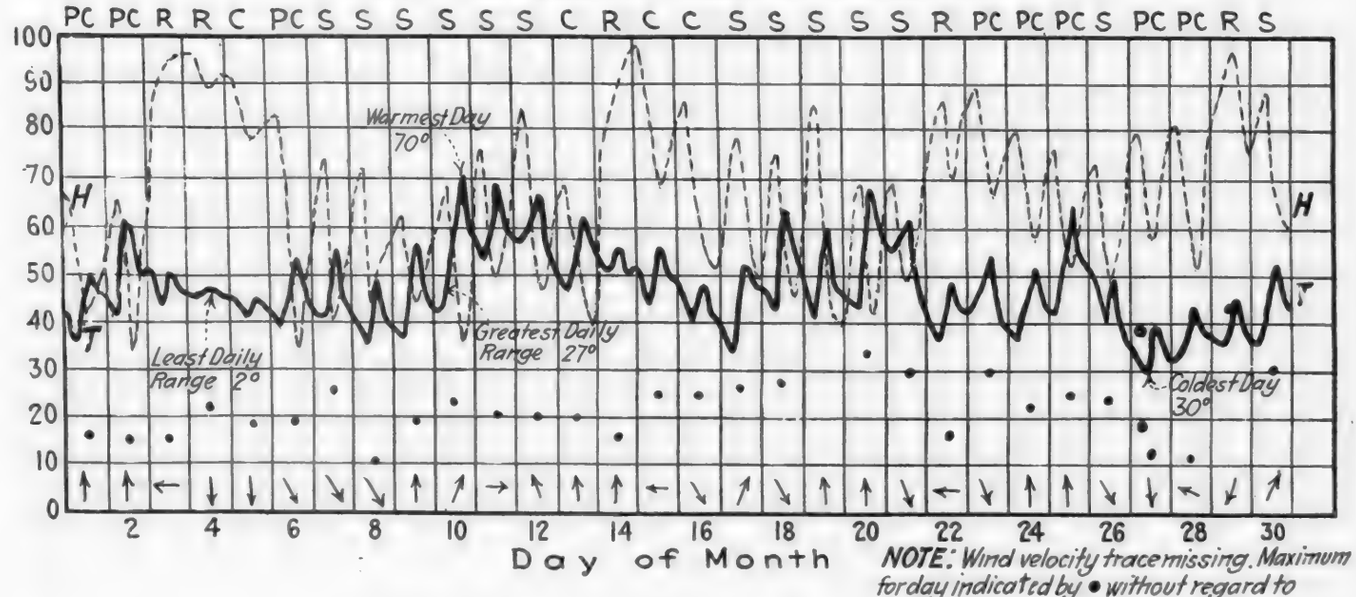
W
Day of Month

Record of the Weather in Pittsburgh for November, 1923


S S R R R S C PC S S S S C C R C S PC PC S C PC R C C C C C R R
Warmest Day 62°
Greatest Daily Range 24°
Least Daily Range 4°
Coldest Day 31°
H
T
W
Day of Month

Record of the Weather in Chicago for November, 1923


PC PC R R C PC S S S S S S C R C C S S S S S R PC PC PC S PC PC R S
Warmest Day 70°
Least Daily Range 2°
Greatest Daily Range 27°
Coldest Day 30°
H
T
Day of Month

NOTE: Wind velocity trace missing. Maximum for day indicated by • without regard to hour of occurrence

Record of the Weather in St. Louis for November, 1923

Plotted from records especially compiled for THE HEATING AND VENTILATING MAGAZINE, by the United States Weather Bureau.
Heavy lines indicate temperature in degrees F. Light lines indicate wind in miles per hour.
Broken lines indicate humidity in percentage from readings at 8 A. M., 12 M., and 8 P. M.
S—Clear, PC—partly cloudy, C—cloudy, R—rain, Sn—snow. Arrows fly with prevailing directions of wind.

Correspondence

Errors in Figuring Humidity Problems.

EDITOR HEATING AND VENTILATING MAGAZINE:

I have been greatly interested for years in humidity and its influence on health and on the saving of fuel. When I saw listed, in a bibliography in a certain medical work, your article on "A Simple Method of Figuring the Economy of Humidity" I thought I had what I had been looking for for some time. I am not a heating expert. I am a minister but have made humidity a kind of a hobby and hold patents for a device that utilizes the waste heat that goes up the chimney flue for humidifying water and projecting it into the home. I may say that Dr. Ellsworth Huntingworth of Yale, who is chairman of the American Research Committee on "Atmosphere and Man," has chosen this from all other devices for his new home in New Haven.

May I presume to point out what seem to me to be errors in the article in your magazine.

In the third paragraph you make out that 1.6 grains per cubic foot would be all that would be required to be added to the air to raise it, at a temperature of 35° F. and with a relative humidity of 40%, to a relative humidity of 60% at a temperature of 70° F. Would it not require much more than that? A cubic foot of air at 35° will hold approximately 2½ grains. At 40% relative humidity it would contain 40/100 of 2½=1 grain. One cubic foot at 70° is able to hold about 8 grains. To have 60% relative humidity it would require 60/100 of 8.0=4.8 grains. Thus 3.8 grains would require to be added, instead of 1.6.

Then in the fifth paragraph you estimate the saving because of humidity to be 14 1/3%. If I understand the article correctly you make out that it would require only one-seventh of the fuel to raise the temperature of a home from 65° to 70° when outside temperature is 35°. Have you not worked on the assumption that it does not require any more heat units to raise a room from 65° to 70° than from say 35° to 40°? Is this correct? To raise a room from 35° to 40° when the outside temperature is 35° would require X heat units. To raise it from 40° to 45° would require 2X heat units because the radiation between 40° and 45° would be twice as great as between 35° and 40°. Therefore to maintain the room at a temperature of 45° would require 2X+1X, or 3X to raise a room from 65° to 70°.

When the temperature was 35°, it would 7X heat units or seven times as much as to raise it the first five degrees and to maintain it there would require the X that was necessary to raise it from 35° to 40°, plus the 2X required to raise it from 40° to 45°, plus the 3X required to raise it from 45° to 50°, plus the 4X required to raise it from 50° to 55°, etc., which equals 21X plus the 7X required to raise it from 65° to 70°, which equals 28X. This means that there would be a saving of one-third, rather than one-seventh, or 33 1/3% rather than 14 1/3%. Am I not right in this?

Again, in figuring out the saving humidity would make, you failed to take into account the fact that humidity being a good conductor equalizes the temperature of a room. It makes considerable of it down from the upper part of the room where it is not needed and adds it to the lower part of the require room where it is required. On a cold day the saving in this respect is considerable. I have made experiments along this line and have been amazed at the results. For instance, on a cold day in winter when the thermometer registered somewhere about the zero mark I should think, I found there was a difference of upwards of 20° between the temperature at the floor and that at the ceiling, when the air was dry, while there was a difference of only 10° when the room was filled with humidity.

In our Northern climate where the thermometer freqquently remains down about the zero mark for days and sometimes for a couple of weeks in winter, it is then that the bulk of the coal is consumed and it is then that humidity is most required from a health standpoint and also from the stand point of economy.

I wonder if I might not ask you to figure for me the saving that humidity would effect at a temperature of zero with a relative humidity of 50%, instead of 25%, which it would have at that temperature if the room were not artificially humidified.

J. D. MACLACHLAN.

Waterford, Ont.

Apparently our correspondent has not noticed the statement which is repeated in the second paragraph that the *inside* relative humidity is 40%, and, as this is relative to 70° (not 0°); to increase the humidity of the inside air from 40% to 60% would require the difference (20%) between the weight of moisture at the two percentages, or 1.6 grains. Obviously, 40% relative humidity at 70° is different from 40% relative humidity at 0°.

As to the fifth paragraph, from 35° to 40° to 45° it takes X heat units plus X heat units, or 2X heat units, not 3X; in other words, it takes 2X heat units from 35° to 45°, not from 40° to 45°. The heat loss is proportional to the difference in temperature, but our correspondent has assumed that it increases rapidly at each 5° rise until at 70° it is 28X. The fallacy of this reasoning may be readily seen if we take Y for each 1° rise, instead of X for each 5° rise, as the result would then be 2585Y, or as X=5Y, then 2585Y÷5=517X units, instead of 28X. To reason along such lines would produce a different result each time the rise in temperature was varied, but if our correspondent will lay aside the X and view the matter as shorn of complications, he will readily see that a man climbing a ladder at a uniform rate does not climb from rung 40 to 45 twice as fast as he climbs from rung 35 to 40.

Commenting on the uniform temperature where air is humidified, it also may be said that under other conditions of heating the uncomfortable difference in temperature between the parts of a room that are near and those that are remote from a radiator is a familiar experience.

The conditions of our correspondents' problem which he wishes figured are not clear. Thus, outside air at 0°, even though saturated, would not contain enough moisture to supply 25% relative humidity at comfortable inside temperatures. In view of this, it can only be pointed out that the "Comfort Zone" chart gives temperatures of 72° and 66.5° for relative humidities of 50% and 25%, respectively. Any saving that might be made will be according to the difference between these two temperatures for the humidities assumed and can be worked out as per example in the article under consideration.—T. W. R.

English Fan Design in Line with Latest American Practice.

EDITOR HEATING AND VENTILATING MAGAZINE:

Your magazine is always interesting, but I do not think it has contained an article which, to me, has been of more interest than the one by Mr. Arthur L. Greene, in the October issue, dealing with a new design of fan casing brought out in America.

The novelty, to your United States readers, will probably be the side plates supporting the casing and bearing.

Enclosed you will find photographs or illustrations of centrifugal fans with side plates which were designed by us fourteen or fifteen years ago and they have been manufactured and sold in this country ever since. If you will compare your illustrations with those enclosed, I believe you will find the similiarity somewhat striking.

Please believe I am writing in quite a friendly spirit, but I would like your readers to know that we, in Great Britain, are not "behind the times" in fan design. Do you think I would be right, in this particular instance, in saying that we were fourteen or fifteen years "ahead of the times"?

OSWALD STOTT,
Managing Director, Standard & Owald Stott,
Leicester, England.

A Conception of Heating as a Three-Fold Problem

EDITOR HEATING AND VENTILATING MAGAZINE:

It seems to me that all of our confusion of thought on heating matters would be cleared up did we but recognize that every heating problem is made up of three separate and distinct problems, each one of which must be successfully solved before the proper answer can be found for the problem that all three combined make. These three problems are one of manufacture, one of transportation, and one of storage.

Heating men usually are concerned only with the transportation phase of the heating problem. Yet they attempt to transport heat that the "heat factory" will not produce, either because it does not exist in the fuel supplied, or because the chimney furnished leaks like a sieve, or is too small for the quantity and character of the fuel to be made into heat, or is not of adequate height for the particular type of furnace in which it is attempted to convert the fuel into heat, or that human nature that handles the fuel is ignorant of the proper attention the particular combination of type of furnace, fuel and chimney should have, or a combination of all these items.

Again, when the structure into which they

are to transport the heat leaks it faster than they can transport it, few of them recognize that this is a problem of faulty storage. We have much literature which aims to show how to calculate heat leaks, with the idea of providing more capacity to take the place of that which leaks away, but none of the textbooks tell us how to build so as to store what is so expensively made and so costly to transport. J. M. ROBB.

Peoria, Ill.

Heating Contractors to Study Seasonal Employment.

Following a discussion of the subject of labor conditions at a recent meeting of the Secretaries of Local Heating and Piping Contractors Associations east of the Mississippi River, held in New York, December 3-4, the conference authorized the appointment of a committee to study seasonal employment and the establishment of a scientific basis for wages.

In this connection the New York City Association submitted a chart showing the variations in employment during the past year (October, 1922, to October, 1923) as compared with a three-year average and with building permits issued.

In this chart, which is reproduced herewith, the monthly averages are for the three years from October, 1920 to October, 1923. The figures for the single year are those for the months from October, 1922, to October, 1923, inclusive. All values on this chart have been reduced to percentages of fixed bases for each curve. The base for the employment curve and the base for the permit curve were arbitrarily chosen so that the curves would lie close enough together to permit easy comparison.

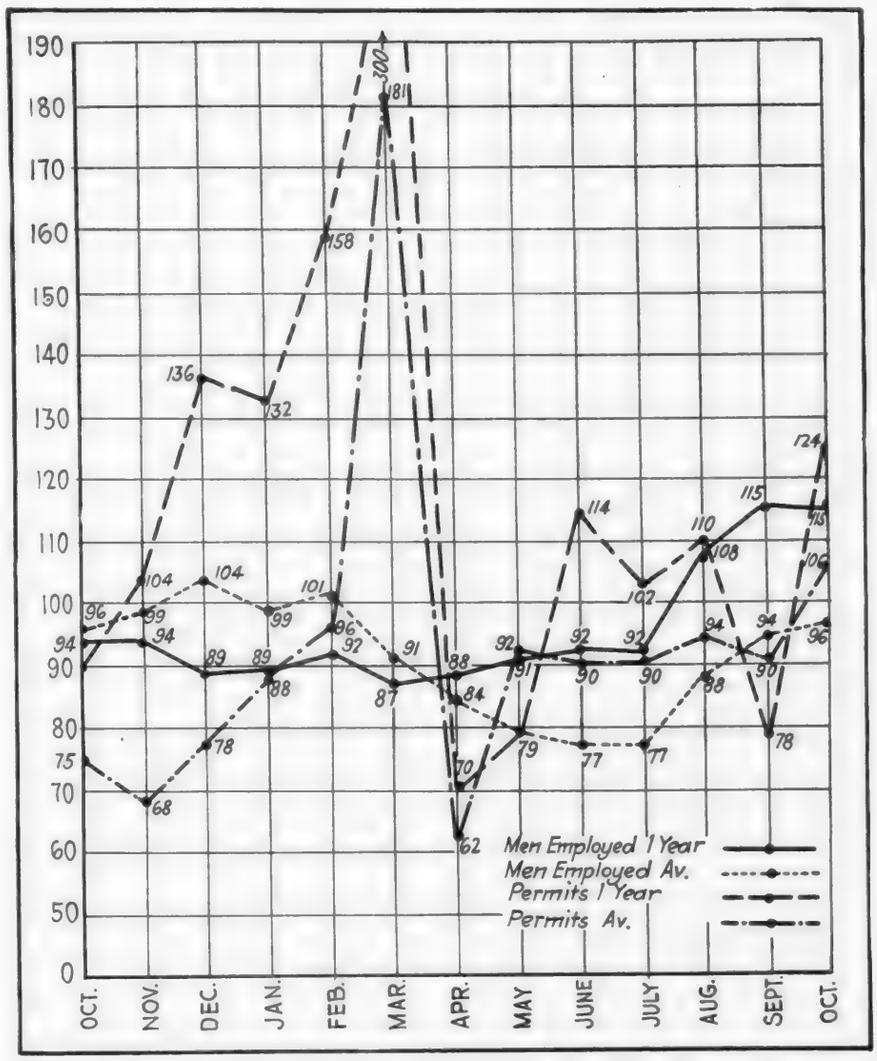
The values used are given in the following table:

	Men Employed, One Year	Men Employed, Average	Building Permits, One Year	Building Permits, Average
October	94	96	90	75
November	94	99	104	68
December	89	104	136	78
January	89	99	132	88
February	92	101	158	96
March	87	91	300	181
April	88	84	70	62
May	91	79	179	92
June	92	77	114	90
July	92	77	102	90
August	108	88	110	94
September	115	94	78	90
October	115	96	124	106

Heating Contractors to Meet in Atlantic City May 26-29.

Announcement is made that the thirty-fifth annual convention of the Heating and Piping Contractors National Association will be held in Atlantic City, May 26-29, 1924. Headquarters will be at the Chalfonte-Haddon Hall. A convention committee has been appointed consisting of W. H. Driscoll, New delphia; and Henry B. Gombers, New York. This action was taken at a meeting of the board of directors of the national association, held at its headquarters in New York, December 3-4.

Mention was made of the fact that the standard roughing-in dimension of ½-in. return-line vacuum valves would become effective January 1, 1924. This dimension is the "center of valve to face of inlet spud" and is now standardized at 3¼ in. In accordance with this action heating contractors are urged to specify return line valves in this standard size so as to take advantage of this latest advance in standardization. This, it is stated, can be readily done as assurances have been received from various manufacturers that they will be prepared to furnish valves of the standard roughing-in dimension after January 1.



Variations in Employment of Steamfitters in New York City During Past Year as Compared with Three Year Average and with Building Permits Issued

Practical Demonstration of Heaters Using Buckwheat Coal

The first of a series of exhibitions, arranged by the anthracite coal operators and nine heating manufacturers, to demonstrate the practicability of burning the smaller grades of coal, was held in Philadelphia recently. Similar exhibits are being arranged for New York, Washington and Boston.

Advertisements inviting the public to visit the exhibition called attention to the fact that the smaller grades of coal, such as buckwheat, rice and barley coals, always are available and can be bought at prices $8.00 to $10.00 per ton cheaper than the egg, stove and chestnut sizes.

Visitors were given actual demonstrations in installations made by the following companies: Domestic Stoker Co.; Keystone Supply & Manufacturing Co.; W. P. Mackenzie & Co.; Abram Cox Stove Co.; Molby Boiler Co.; Philadelphia Steam Heating Co.; Standard Heater Co.; Burn-Buck Co.; and the Culm-Burn Equipment Co.

The demonstrations were planned for the benefit of householders, few of whom know how to utilize the smaller coals. Anthracite operators stress the fact that the smaller grades of coal are the same kind of coal usually burned, except for the size, and that they must necessarily be produced in the preparation of the larger coal.

Cleveland, O.—Heating and Piping Contractors of Cleveland, O., elected the following officers at its annual meeting at the Hollenden Hotel, December 10: President, M. L. Crowell, Crowell-Smith Co.; vice-president, W. C. Clark, Becker-Seidel Co.; secretary, W. B. Van Sickle, W. B. Van Sickle Co.; treasurer, A. E. Welker, Price & Welker; sergeant-at-arms, W. F. Hann; executive committee: A. L. Becker, A. L. Becker Co.; George Spohn, Spohn Heating and Ventilating Co.; R. H. Morgan, Chappell-Warren Co.; F. M. Daugherty, Grinnell Co. Inc.; and Edward Maurer, Maurer Bros. Co.; During the course of the dinner which concluded the meeting, President M. A. Crowell, who is entering his third successive term, was presented with a watch and watch guard, on behalf of the association, by R. H. Morgan, chairman of the entertainment committee. The toastmaster was F. M. Daugherty.

National Trade Extension Bureau

Another Suggested Window Display of Heating Equipment.

A window display well calculated to arouse interest in heating equipment in general, and in the vapor system of heating in particular, is suggested by the National Trade Extension Bureau in the arrangement here illustrated.

The back and sides of the window are intended to be draped with dark cloth hanging from a wire. The ornamental background behind the radiator is two pieces of wall board, shaped alike and painted a light color. The two pieces are nailed on a wooden strip up the center. These are to be placed in the rear center of the window.

In front of the background a pedestal about 18 in. high, is arranged for the radiator. In front of that again is a pedestal about 5 in. high for the gas plate and tea-kettle.

Pedestals with sloping tops about 18 in. high are to be placed one at each side at front of window, the tops being covered with black cloth. Gray cloth is then tacked around the front and side edges of the black tops and draped to the floor, as in the illustration. The floor and other pedestals should be covered with the same kind of cloth, allowed to fall into natural folds.

The radiator should be shown equipped, as if in actual use, with supply valve and trap. The gas plate under the tea-kettle should also appear the same. From the spout of the kettle to a nipple in the supply valve is run a length of rubber hose. Finally, on the sloping tops of the pedestals, at the sides of the window, are fastened samples of the air valves and traps which it is desired to display.

The cards read: "Good air valves save their cost in a hurry. Please ask us how and why." "Efficient traps will end many heating troubles. Let us explain their economy."

How Apprenticeship Affects You.

How vital an interest the entire heating industry should have in the subject of apprenticeship is brought out very clearly in a circular just issued by the National Trade Extension Bureau. For instance, in the diagram reproduced herewith it is shown how the manufacturer and wholesaler cannot expand faster than the others without causing breaks all along the line. The consumer cannot increase his demands beyond the capacity of the journeyman to install what he purchases. The contractor cannot make any money on the jobs he turns down because of labor shortage. It cuts the journeymen's profits, too, in the long run, because it brings out a supply of half-baked mechanics who are the competent man's worst enemy.

The second diagram shows the extent of the shortage of apprentices in the plumbing industry (which could be duplicated in the heating industry) and visualizes the present need of more apprentices. In the plumbing field there are 25,000 less mechanics to-day than there were thirteen years ago, although the population has increased 18,000,000, while the consumption of equipment has more than tripled. Moreover, the deficit is increasing.

As the circular points out, it takes four to five years to train a journeyman, so that we must begin now to take steps to

Diagram Showing Interrelation of Different Elements of Heating or Plumbing Industry

make up the deficit or else in ten years' time we shall be in desperate straits.

The public schools, it is stated, are eager to help. Labor organizations are finding that the new apprenticeship is fair to them and they are supporting it. Manufacturers and wholesalers are giving time and effort and funds to promote the training idea. The general public sees the need for more apprentices to insure future housing. Finally, big employer organizations are backing training.

According to the bureau, the shortage will not be made up until there is at least one apprenticeship in every shop.

Among the practical suggestions offered by the bureau are the following:

Inform yourself of apprenticeship needs and plans for meeting these needs.

Use your personal and business influence to realize the aims of the New Apprenticeship. If you are a contractor, hire and train one or more apprentices.

Contribute time, effort and money to the solution of the problem in your own community.

Give funds for the education of the general public, of backing backward contractors and others, and for the development of better means of training.

Talk apprenticeship everywhere, with everybody.

Although the details of the "New Apprenticeship" Plan of the National Trade Extension Bureau have already been presented in these columns (see THE HEATING AND VENTILATING MAGAZINE for July, 1923) the following summary is presented to show at a glance the main features of the plan:

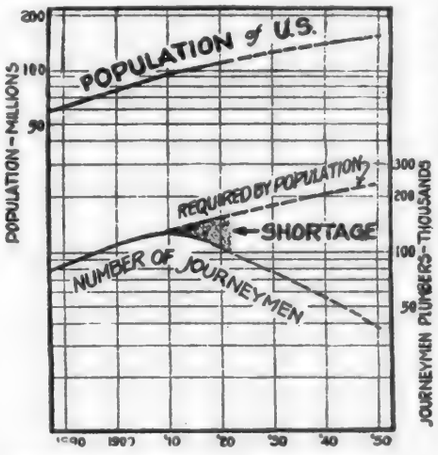
I. *An Apprenticeship Committee in every Community,* composed of representatives of every interest: employee organizations, employers, schools, manufacturers and wholesalers, general public—everybody that is affected, everybody that can help. This committee is to be responsible locally for

Suggestion for Window Display of Heating Equipment

a. Promotion of apprenticeship through education of the community;
b. Providing of adequate opportunities as listed below;
c. The drafting and enforcing of fair apprenticeship regulations;
d. Co-operation with local public school authorities to provide training.

II. At Least One Apprentice in Every Shop.

Every heating and plumbing contractor should bear his share of responsibility by employing and training at least one American boy constantly.



Extent of Shortage of Apprentices in Plumbing Industry

III. Adequate Opportunities for Every Apprentice.

These comprise:

a. Adequate training in resident or correspondence courses in the practical work of the trade—skill; the technical phases of the trade—knowledge; the past, present and future of the trade—visions, ideals.
b. Guarantee of continuous employment through the period of apprenticship.
c. Guarantee of opportunity to learn the whole trade, as opposed to learning a specialty only.
d. Guarantee of a fair wage scale based on a percentage of the going journeymen's wage.

IV. Aid from the Bureau in Carrying Out this Program:

a. Publicity to all interests; employers, journeymen, manufacturers, patents, present and prospective apprentices, the general public.
b. Framing of instructional material to be furnished at cost to schools wishing to use it (The bureau has prepared a "Standardized Course of Training for Apprentice Plumbers.")
c. Organization of community schools, aiding in every way the putting of this program into effect in individual communities.
d. Training of instructors of apprentices through correspondence and short resident courses.
e. Surveys and investigations to determine the exact status of apprenticeship in various communities and States.

Treasury Report on Public Building Construction Needs

An idea of the construction needs of the Treasury Department is contained in the annual report of the Secretary of the Treasury for the fiscal year ending June 30, 1923, and recently made public. "A serious condition of congestion," states the report, "exists in the federal buildings in the more important cities throughout the United States, and the government is paying for space to accommodate the public business approximately $20,000,000 annually. This figure is mounting steadily. While there is great need for public buildings in many cities not already provided with such buildings, there is greater need for the extension and enlargement of many of the public buildings hitherto constructed, and it is believed that preferential consideration should be given to this phase of the public building situation."

. . .

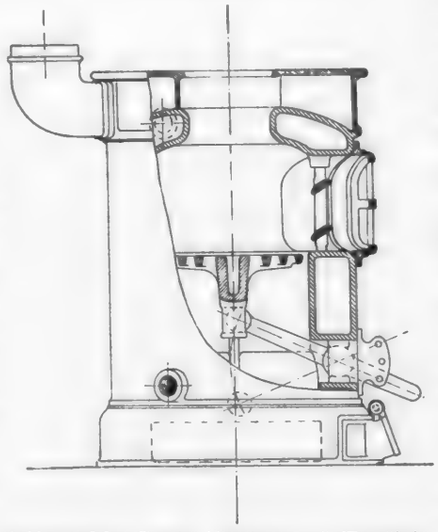
"A matter of equally pressing urgency is the need for certain additional buildings for governmental purposes in the city of Washington.

Of the ten executive departments, the War and Navy Departments are occupying temporary buildings belonging to the government, the Departments of Justice, Commerce, and Labor are in rented quarters, while the Treasury Department and the Department of Agriculture are only partially accommodated in their respective departmental buildings and are occupying outside quarters, rented and otherwise, in excess of the space provided in said departmental buildings."

New Apparatus and Appliances

A Boiler with Adjustable Grate.

A unique grate arrangement is embodied in an English type of "boiler-stove" brought out by John Robinson, Ltd., Ecclesfield, Sheffield, and described in *The Plumber and Journal of Heating,* of London. As will be seen from the accompanying illustration, the



Adjustable Grate Feature of English Boiler

grate is adjustable so that the firepot may be reduced or enlarged at will.

This heater is known as the "Daornite" boiler. In addition to the adjustable grate feature, the crown of the boiler is so arranged that the heated gases are forced to make a complete circuit beneath the hot plate, thus increasing their effectiveness.

These boilers are made in three sizes, rated to provide from 40,000 to 70,000 B.T.U. per hour, this being equivalent to raising 40 to 70 gal. of water through 100°F., that is, from 50% to 150% F. These ratings are calculated on 7000 B.T.U. per square foot of heating surface in the boiler.

New Hoffman Air and Vacuum Valve.

A new air and vacuum valve, designed for use with one-pipe heating plants, has been designed by George D. Hoffman, president of the Hoffman Specialty Co., Waterbury, Conn. It is being marketed under the name of the No. 2 Hoffman air and vacuum valve. Mr. Hoffman's reputation as an inventor of air valves and other heating specialties lends special interest to his latest product which is designed to freely vent the air but to automatically close when steam condenses, thereby preventing the return of air into radiators and pipes. The installation of these valves on a one-pipe system, it is stated, will convert it into a vacuum system, possessing the temperature range of hot water and the flexibility of steam.

The new valves are of the same standard of design and construction as the No. 1 Hoffman valve which has become familiar to the trade through its sobriquet of "The Watchman of the Coal Pipe."

New Portable Recording Instrument

Among the recent developments by the Westinghouse Electric and Manufacturing Company is a portable recording instrument known as Type R. It is made for applications where records as accurate and reliable as those obtained with large switchboard instruments are necessary. Such applications include analysis of motor operation, typical consumption curves of large in-

New Type of Portable Recording Wattmeter, Three-Phase, A. C.

dustrial consumers, and records of power distribution.

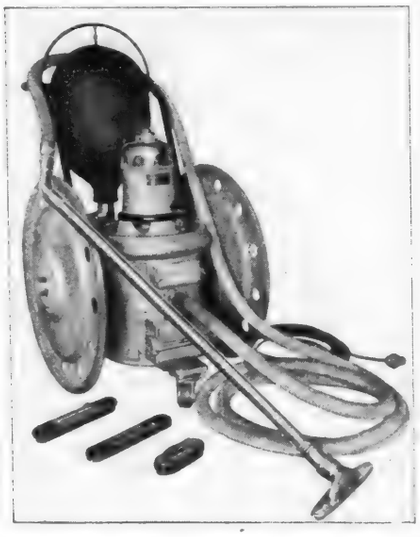
The Type R instrument is an adaptation of the switchboard recording instrument, with the element as a whole mounted in a portable carrying case. An electric self-winding clock is used for speeds up to 24 in. per hour. For slower speeds, up to 4 in. per hour, a hand-wound clock can be used.

Alternating-current ammeters, alternating and direct-current voltmeters, and single and polyphase wattmeters are made in these portable recording instruments.

Portable Electric Vacuum Cleaner For Heavy Duty

A new heavy-duty portable electric vacuum cleaner, known as the Tuec truck cleaner, has been developed by the United Electric Company of Canton, Ohio. This cleaner is particularly adapted for such buildings as hotels, office buildings, hospitals and churches not equipped with stationary vacuum cleaner service, as well as for auxiliary service in buildings having such installations.

A horizontal fan, revolving on a shaft driven by a 5/8-H. P. Westinghouse motor, draws the refuse through the nozzle and into the separation chamber. In this chamber a metal screen of coarse mesh is provided to



Heavy-Duty Portable Vacuum Cleaner, Showing Swivel Nozzle and Accessories

separate the heavy dirt and litter from the finer dust. The heavy dirt drops into a dirt drawer at the bottom of the chamber, while the dust passes through the screen and out of the chamber into two dust bags mounted at the rear. The lower of these bags catches the heavier dust, while the upper one is filled with the lighter particles. The bags are open at one end only and are detachable.

The machine is mounted on two 30-in. rubber-tired disc wheels and may be operated in a 75-ft. radius from any electric connection. It is 48 in. high, 30 in. wide, and 36 in. long, so that it may be moved in narrow aisles and carried in elevators. The weight of the truck, without accessories, is 280 lbs. It is furnished with 25 ft. of light hose, a 42-in. aluminum or steel handle, and five tools for use in cleaning carpets, hardwood floors, walls, draperies, upholstering, and clothes.

Success of Second Annual Power Show in New York.

Both in the number of exhibits and in the attendance, the second National Exposition of Power and Mechanical Engineering, held at the Grand Central Palace, December 3-8, established a mark far exceeding the record made by the first show and, in fact, comparing favorably with any of the important shows in other lines.

Two floors were necessary to accommodate the exhibits. Among those of special interest to heating and ventilating engineers were the following:

Alberger Heater Co., Buffalo, N. Y., heaters, oil coolers and evaporators.

American Brass Co., New York, condenser tubes and brass pipe.

Amercan Schaeffer & Budenberg Coporation, Brooklyn, N. Y., indicating and recording gauges and thermometers, valves and fittings.

American Steam Gauge & Valve Mfg. Co., Boston, Mass., gauges, valves and specialties.

Armstrong Machine Works, Three Rivers, Mich., steam traps.

Armstrong Mfg. Co., Bridgeport, Conn., stocks and dies.

Ashton Valve Co., New York, gauges, gauge testers and master pilot gauges.

Bailey Meter Co., Cleveland, O., meters for steam, water, coal, air and gas; also recording and indicating tachometers.

Ballwood Co., New York, pipe, bends and coils.

Barnes & Jones, Boston, Mass., modulation valves, radiator traps and other heating specialties.

Bristol Co., Waterbury, Conn., recording pressure and vacuum gauges, indicating and recording thermometers, etc.

Bundy Steam Trap Co., New York, steam traps.

Carling Turbine Blower Co., Worcester, Mass., turbine-driven fans and blowers.

A. W. Cash Co., Decatur, Ill., pressure-reducing and regulating valves, expansion and relief valves.

H. S. B. W.-Cochrane Corporation, Philadelphia, Pa., De-aerating heaters, multiport back-pressure valves, drainers, etc.

Coen Co., New York, oil burners.

Crane Co., Chicago, Ill., valves, fittings and specialties.

Crosby Steam Gage & Valve Co., Boston, Mass., indicating and recording gauges; also safety, blow-down and relief valves.

M. T. Davidson Co., New York, steam pumps.

Julian D'Este Co., Boston, Mass., damper regulators, reducing valves and steam regulators.

Elliott Co., Jeannatte. Pa., blowoff valves, steam and oil separators, strainers and test kit for determining corrosiveness of water.

Fisher Governor Co., Marshalltown, Ia., pump governors, reducing valves and pressure regulators.

Foster Engineering Co., Newark, N. J., pressure regulators, non-return valves and pump governors.

Foxboro Co., Foxboro, Mass., indicating and recording gauges and thermometers and Co_2 recorders.

Fulton Co., Knoxville, Tenn., temperature regulators, valves and other Sylphon specialties.

Gillis & Geoghegan Co., Inc., New York, telescopic hoists for ash removal.

Graver Corp., East Chicago, Ind., hot-process water softeners.

Griscom-Russell Co., New York, U-fin generator air coolers, air ejectors, evaporators, heaters and oil coolers.

Howard Iron Works, Buffalo, N. Y., feed-water heaters and expansion joints.

Jenkins Bros., New York, valves and fittings.

Keasbey & Mattison Co., Ambler, Pa., magnesia pipe and boiler covering.

Mason Regulator Co., Dorchester, Mass., reducing valves, pump, pressure and damper regulators.

Midwest Air Filters, Inc., air filters, etc.

Nash Engineering Co., So. Norwalk, Conn., compressors and pumps.

Nelson Mfg. Co., Philadelphia, Pa., valves, fittings and specialties.

Power Specialty Co., New York, Foster superheaters and economizers.

Pratt & Cady Co., Inc., Bridgeport, Conn., valves and fittings.

Reading Iron Co., Reading, Pa., cast-iron pipe.

Reed Air Filter Co., New York, air filters.

Reliance Gauge Column Co., Cleveland, O., safety water columns.

Republic Flow Meters Co., Chicago, Ill., meters for steam, water, air and gas, draft indicators and recorders, etc.

Sarco Co., Inc., New York, steam traps and specialties.

Smith & Serrell, Newark, N. J., flexible couplings and rigid couplings, etc.

C. J. Tagliabue Mfg. Co., Brooklyn, N. Y., indicating and recording thermometers, automatic controllers for pressure and temperature, etc.

Uehling Instrument Co., Paterson, N. J., Co and Co_2 recorders, etc.

Union Steam Pump Co., Battle Creek, Mich., steam pumps.

Walworth Mfg. Co., Boston, Mass., globe and gate valves, fittings and specialties.

Warren Webster & Co., Camden, N. J., modulation system of steam heating, with electric-heated steam boiler, feed-water heaters, Sylphon quick-opening packless valves, etc.

Watts Regulator Co., Lawrence, Mass., feed-water regulators; also damper and pressure regulators and pump governors.

L. J. Wing Mfg. Co., New York, turbine blowers.

American Peace Award Referendum

The Policy Committee of the American Peace Award, created by Edward W. Bok through an offer of $100,000 for the "best practicable plan by which the United States may co-operate with other nations to achieve and preserve the peace of the world" is conducting a nation-wide referendum this month on the plan which won the award. More than 4,000 papers, dailies and weeklies, and trade journals, are participating in the referendum. The committee in charge feels that in this way the people are given a direct opportunity if expressing themselves upon the plan chosen by the Jury of Award.

The text of the plan selected by the Jury of Award will be published widely or may be obtained from The American Peace Award, 342 Madison Avenue, New York City, and readers of THE HEATING AND VENTILATING MAGAZINE are urged to send in their ballots, voting "Yes" or "No" on the plan.

New Year Holds Good Promise

Further Improvements Likely During Spring Season. Review of the Past Year

Especially Prepared for THE HEATING AND VENTILATING MAGAZINE

By L. W. Alwyn-Schmidt

THE year 1923 has gone into history and 1924 has made its bow. The time, no doubt, is appropriate to look back upon the past year, not so much for the purpose of reviewing its history but rather to find out how its happenings are likely to influence the course of economic events during the new year.

Those readers who have followed carefully the market each month will remember how we voiced increasing optimism early during the year, predicting, however, a likely flattening out of the economic movement on its top and a slight decline immediately after the highest elevation had been reached. It was, to speak in the headlines of our report "General Outlook Satisfactory" in April, "National Prosperity Increases" in May, "Improvement Continuous" in June. In July appeared the first sign of a slowing down of the upward movement, less rapid progress with "Market Shows Great Steadiness" followed by "Market Retains Favorable Aspects" in August. "Situation Requires Caution" was the key note of September, with a second warning in October that "Business Moved Upon A Slightly Lower Level." Again we had "Outlook Grows Brighter" in November, the year ending up with advice to the consumer that "This is a Buyers' Market."

Truly and correctly have these headlines described from month to month the changing course of business, taking a conservative estimate of each event as it might influence the market and endeavoring to guide the reader through what was one of the most complicated business situations met with in many a year.

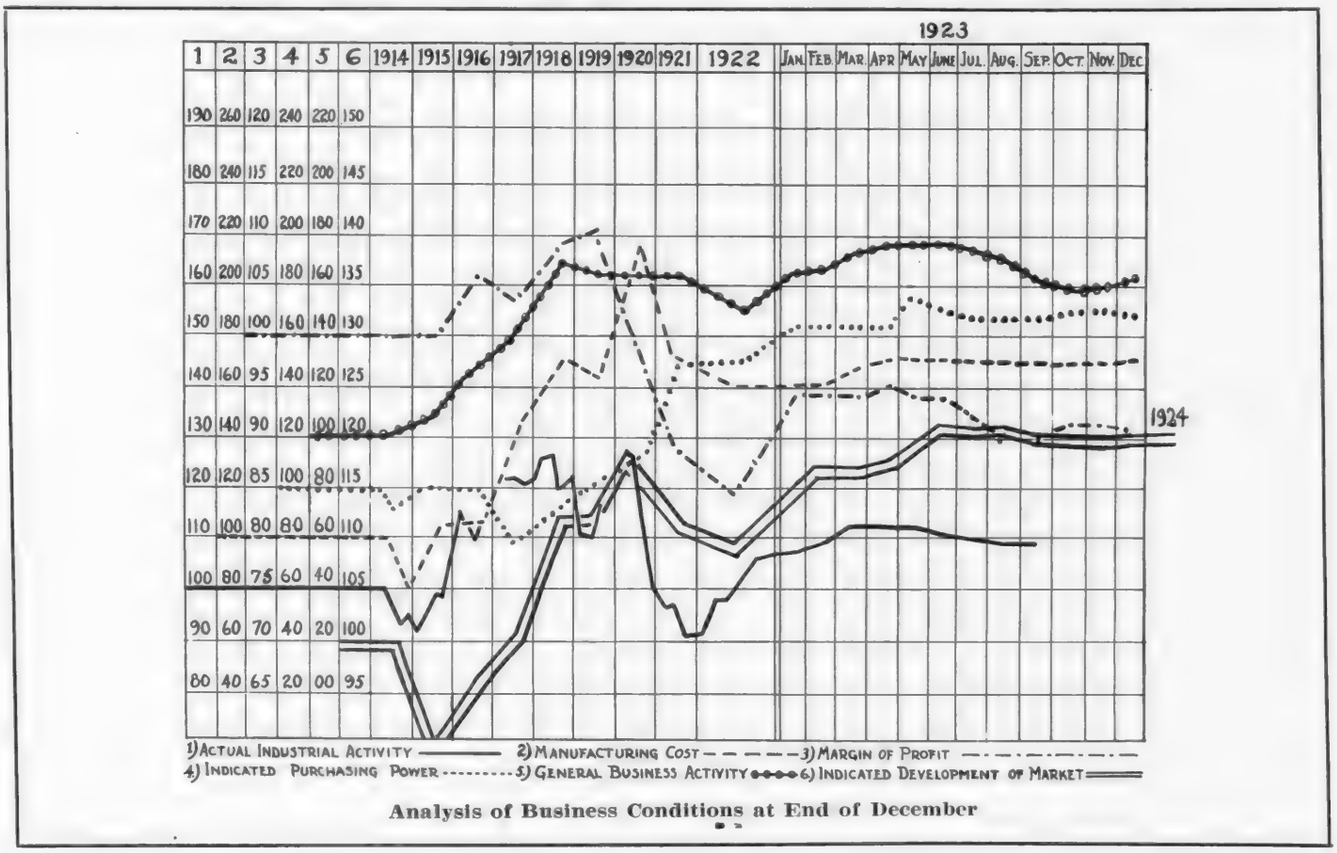
Now the New Year has come and it will have to take over the inheritance of last year. It starts with a new promise but there is still plenty of reason for caution. 1923 was a year for the man who plays safe and it repaid well the efforts of those able to take care of its opportunities. There has been all along no real danger. It did not exist when the cry was raised of inflation early in the year. Nor could it be found in the second half when many judges of the situation were inclined to take an unnecessarily bleak view of events which, after all, were only the natural outcome of the somewhat rapid ascendancy during the last half of the year 1922.

The New Year, of course, is only a minor factor in the constellation of the market. Of more importance for the course of business in the change of the various seasons, the length of each as compared with others, and the date of the turning point when business begins to be influenced by the expectations for the new season. We entered autumn riding upon the crest of an economic wave of great underlying strength, with business running in an even flow of hardly perceptible change in speed and energy. This flow has been sustained all through autumn and it still continues evenly now that winter has arrived.

But winter itself is only a date in the calendar. The winter of the business season is determined not by the astronomer but by the weather man. The fall of snow, its quantity, the change of autumn weather to winter weather with their effect upon transportation, clothing, and fuel requirements and the resulting change of life's habits and customs are the real makers of the winter season. And this year's winter has come late, comparatively, with snow reported only in isolated cases. So the early part of the Christmas business has not been a "winter" business. Its transactions were affected by other causes. These causes require some investigation.

According to all available reports the Christmas business has been good. All retail centers have reported good sales and the wholesale trade has had worthwhile orders for emergency shipments to take care of the new year's business.

Owing to the late appearance of winter



Analysis of Business Conditions at End of December

weather this business activity in the retail market was not influenced by seasonal requirements but was the outcome, pure and simple, of the increased purchasing power of the nation pointed out at various times in the course of these articles. While, therefore, this growth in the volume of purchases by itself is sufficient proof of the existence of a strong purchasing power, there is additional proof given by the increase of savings banks holdings which run ahead over previous year at the rate of 10%.

This purchasing force of the nation is now indicated to experience a small impairment owing to the comparatively low price of certain farm products, but it is nevertheless a very useful inheritance to be taken over by the New Year. It will certainly come to full activity only now where the seasonal Christmas business has come to an end. Its strength will depend upon the drain of Christmas purchases upon savings. How much of this Christmas business has been financed out of current earnings or how much was withdrawn from savings banks accounts? An answer, of course, can only be had after another month or two. But with the earning power of a large part of the nation being where it is and living expenses remaining comparatively stationary, it can be expected that the purchasing reseve will soon be established again in full force.

This will be largely aided by the fact that 1924 is not likely to see violent changes in the cost of the leading commodities. The price adjustment unavoidable as an outcome of the recent tariff change came to an end apparently by the middle of 1923. The resulting balance of earning and purchasing power must be very favorable to all business.

The outlook for 1924 is very promising. Developments indicated by the end of 1923 should run a normal course and there is nothing in the present condition of the market heralding a serious disturbance. A new forward movement can be expected with the opening of the spring season in almost all branches of the nation's industry.

New Books.

HEATING AND PIPING CONTRACTORS NATIONAL ASSOCIATION ENGINEERING STANDARDS, comprising the method of figuring radiation developed by the association's Standardization Committee, and including the necessary tables of transmission factors and other constants, has been placed on general sale at $5.00 per volume. When the manual was first issued, its circulation was confined to members of the association. However, the number of requests for copies from other sources indicated that the association could perform a real public service by making the book available to all interested.

The manual is a loose-leaf volume of 49 pages, containing, in addition to the tables, a "Foreword," in which the method of arriving at the results is given and the formula for figuring radiation. The data pages contain transmission factors for the various types of building construction, tables of temperature factors for outside temperatures ranging from—20° to 20° F, and room temperatures ranging from 40° to 80° F. There is also an infiltration table covering the inleakage of the various types of doors and windows, a table of base temperatures and exposure factors for a number of important cities, and diagrams of radiator enclosures with the effect of each upon the efficiency of the radiator.

Perhaps the most noteworthy feature of the manual is the table of base temperatures and exposure factors because of the method by which it was compiled. The Committee on Standardization realized that ordinary mean temperatures, minimum temperatures, average wind velocity and prevailing directions, as often published in weather bureau statistics, did not give sufficient data for the scientific determination of these factors. Picking out January and February as the critical months of the heating season, photostatic copies of the records of hourly temperatures, hourly wind velocity and hourly wind direction for several years were obtained. These observations, about 13,000 for each city given, were charted and compared so that the results as published cover any condition which may be anticipated in the city under consideration.

It was found that the base temperature we have been accustomed to use, that is, 0° F., in most cases is erroneous when it is taken into consideration that all the factors of transmission and infiltration are based upon a 15-mile wind velocity per hour. Chicago, for instance, which has always been figured wiht a—10° base temperature, under the new method as outlined in the manual, is given a base temperature of 10° and, surprising as it may seem, west was found to be the worst exposure and effects southwest and northwest to the same extent, necessitating the addition 33 1/3% to wall and glass and infiltration on these points of the compass. Northeast and east and southeast requires no additional radiation beyond the basic calculations, whereas south requires 15% to be added to compensate for severe southwest winds. Likewise north requires the addition of 25% to compensate for severe northwest winds.

Engineering Standards is published by the Heating and Piping Contractors National Association, 50 Union Square, New York, or may be had through the book department of THE HEATING AND VENTILATING MAGAZINE. Price, postpaid, $5.00.

TRANSACTIONS OF THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Vol. 27, for 1921, has been issued. These transactions cover the annual meeting of the society held in Philadelphia in January of 1921, and the semi-annual meeting in Cleveland, in June of the same year. In addition to the papers and reports as presented at those meetings, the volume contains the discussions, in many cases revised and extended. The complete volume comprises, with index, 416 pages.

New Publications.

ENGINEERING ACHIEVEMENTS of the Westinghouse Electric & Mfg. Company for the year 1923 form the subject of an impressive circular appearing under the name of H. W. Cope, assistant director of engineering for the company. The wide extent of the company's activities are seen in the variety of subjects discussed under the general headings of: generation, transmission and distribution of power; static condensers for power factor correction; railways; navy and merchant marine; radio and industry. One of the sub-titles under the latter heading is "Industrial and Domestic Heating, the achievements in this line, however, being practically confined to industrial heaters. Under the final heading of "Educational," is given an account of the company's activities in disseminating accurate information covering the many phases of its activity. A description is also given of the latest laboratory equipment constructed by the company, including the 1,000,000-volt transformer for the California Institute of Technology and the Southern California Edison Company.

CYCLOIDAL MULTIVANE FANS, Standard steel-plate fans, waste heat fans, heaters and heater units, are presented in an attractive catalogue (Sectional Catalogue No. 200) received from the Garden City Fan Co., Chicago, Ill. Each type of fan is illustrated, with corresponding price tables and performance data. First place is given to the Cycloidal multi-vane fans, special attention being called to the curved vanes in the Cycloidal wheel which are set at an angle parallel to the shaft, permitting air from the inlet to flow uniformly the entire width of the wheel. This, it is stated, assures noiseless operation and 100% wheel efficiency. Other details show the pivoted-type and rigid-type bearings. Space is also devoted to high-speed fans and overhung-wheel type fans. The second portion of the catalogue is given over to data on double-width double-inlet units, the "Garden City" direct-connected unit equipped with any standard make of motor, standard steel-plate fans and waste heat fans; also Garden City pipe-coil heaters, made of vertical pipe, width return bends. Attention is called to the company's facilities for building special fan equipment in quantities for a variety of requirements.

Size 7½ x 10¾ in. Pp. 24.

VALVE WORLD, the monthly periodical of Crane Co., Chicago Ill., describes, among other things, the piping features of the new plant of Johns-Manville, Inc., at Waukegan, Ill.

A PROBLEM OF HOT AIR is the keynote of a circular issued by the Foxboro, Mass., calling attention to the company's single draft gauge, duplex draft gauge and triplex draft gauge. The first type, which is a single-pointer indicator, it is stated, can be made for any range for any point of measurement in a boiler. The duplex gauge is especially intended for natural-draft installations, indicating the draft over the firebed and at the last pass. The Triplex gauge is for forced draft installations, and is designed to take care of pit pressure draft over fire, and the last pass, although other combinations are available. Each instrument is illustrated in the circular.

Deaths.

Ralph E. Gilman, special engineer in charge of turbo-generator engineering for the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., died recently in Los Angeles, Calif. He had been granted a leave of absence to visit the Pacific coast in an effort to improve his health. Mr. Gilman was a graduate of Leland Stanford University. He had been connected with the Westinghouse company in the United States and abroad for more than twenty years.

A window like this makes Airid Sales

MANY thousands more Airids are being sold this year than last season. And these sales are being made by Heating Contractors who are displaying Airids where people can see them—and be reminded of the advertising they have read.

The object of every Airid advertisement is to make new users—to get them to try one valve. Our records show that when they try one Airid they come back for more, because one Airid in action sells another for every radiator in the building.

When you invest in Airid Air Valves you do not also have to invest in labor cost to get your profit. You can actually sell them right in your shop, for you know any one can install Airid without any tools—on any radiator.

If you want your share of these "velvet" profits, make your window look like the one above. Right now is Airid profit time.

MADE AND GUARANTEED BY

AMERICAN RADIATOR COMPANY

IDEAL Boilers and AMERICAN Radiators for every heating need

1807 Elmwood Avenue Dept. S 105 Buffalo, N.Y.

WHEN STEAM rushes into a radiator it pushes air ahead of it. Airid Air Valves instantly let this clogging air out so that steam can come into every loop of the radiator—without forcing the fire.

(Stock No. 500)

AIRID Air Valve

Rids the radiator of cold air

THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

TEMPERATURES IN THE UNITED STATES.

Especially compiled for The Heating and Ventilating Magazine from United States Weather Bureau Records.

(Degrees in Fahrenheit).

State and City	Highest of Record	Lowest of Record	Mean Maximum and Mean Minimum ÷ 2	Period in Which Normal Mean Temp. was 60° or lower	Oct. to April, Inc.	Nov. to March, Inc.	Dec. to Feb., Inc.
Alabama							
Anniston	103	–3	61	Oct. 20 to Apl. 20	51	47	44
Birmingham	104	–10	64	Oct. 20 to Apl. 20	54	50	46
Mobile	102	–1	67	Nov. 10 to Mar. 20	59	56	53
Montgomery	107	–5	66	Nov. 1 to Apl. 10	56	53	50
Arizona							
Phoenix	117	16	70	Nov. 15 to Apl. 1	59	56	53
Arkansas							
Fort Smith	108	–15	60	Oct. 1 to May 1	50	45	41
Little Rock	106	–12	64	Oct. 10 to May 1	52	48	44
California							
Los Angeles	109	28	63	Dec. 1 to Mar. 1	59	58	56
Sacramento	110	19	60		55	51	48
San Diego	110	25	64		60	58	57
San Francisco	101	29	56		54	53	51
Connecticut							
Hartford	100	–18	50	Oct. 1 to May 15	38	32	28
New Haven	100	–14	50	Sept. 25 to May 25	38	33	29
Colorado							
Denver	105	–29	50	Sept. 5 to June 10	39	35	32
Pueblo	104	–27	51	Sept. 15 to June 1	39	34	31
District of Columbia							
Washington	106	–15	55	Oct. 1 to May 10	41	38	34
Florida							
Jacksonville	104	10	69	Nov. 20 to Mar. 20	62	59	57
Miami	96	27	75		72	70	68
Pensacola	103	7	68	Nov. 1 to Apl. 1	60	57	54
Tampa	98	19	72		66	64	61
Georgia							
Atlanta	100	–8	61	Oct. 20 to May 1	51	47	44
Augusta	105	3	64	Oct. 25 to Apr. 15	55	51	48
Macon	104	8	64	Nov. 1 to Apl. 10	55	51	47
Savannah	105	8	67	Nov. 15 to Mar. 20	58	55	52
Thomasville	106	2	67	Nov. 15 to Mar. 10	59	55	53
Idaho							
Boise	121	–28	51	Apl. 1 to June 1	40	36	32
Lewiston	110	–23	53	Oct. 1 to May 20	42	39	36
Pocotello	102	–20	48	Oct. 1 to to May 15	36	32	28
Illinois							
Cairo	106	–16	58	Oct. 10 to May 10	46	43	37
Chicago	103	–23	49	Sept. 20 to June 10	37	31	27
Springfield	107	–24	53	Oct. 1 to May 15	40	34	29
Indiana							
Indianapolis	106	–25	53	Oct. 1 to May 15	40	35	30
Evansville	107	–16	57	Oct. 5 to May 5	44	39	36

(Continued on Data Sheet No. 4-D)

TEMPERATURES IN THE UNITED STATES | No. 4-C

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THE HEATING AND VENTILATING MAGAZINE—1123 BROADWAY, N. Y. C.

TEMPERATURES IN THE UNITED STATES.

Especially compiled for The Heating and Ventilating Magazine from United States Weather Bureau Records.

(Continued from Data Sheet No. 4-C)

(Degrees in Fahrenheit).

State and City	Highest of Record	Lowest of Record	Mean Maximum and Mean Minimum ÷ 2	Period in Which Normal Mean Temp. was 60° or lower	Oct. to April, Inc.	Nov. to March, Inc.	Dec. to Feb., Inc.
Iowa							
Des Moines	110	–30	49	Sept. 20 to June 1	36	29	23
Keokuk	108	–27	52	Oct. 1 to May 20	39	32	28
Sioux City	107	–35	48	Sept. 20 to May 25	33	27	21
Dubuque	106	–32	48	Oct. 1 to May 10	34	27	22
Kansas							
Concordia	110	–25	53	Oct. 1 to May 10	39	33	28
Dodge City	108	–26	54	Oct. 10 to Apr. 25	41	35	31
Wichita	107	–22	54	Oct. 10 to May 1	44	38	34
Kentucky							
Lexington	102	–20	55	Oct. 1 to May 10	43	38	34
Louisville	107	–20	57	Oct. 1 to May 10	45	40	36
Louisiana							
New Orleans	102	7	69	Dec. 1 to Apl. 1	62	58	56
Shreveport	110	–5	66	Nov. 1 to Apl. 5	57	52	48
Maine							
Portland	103	–21	46	Sept. 15 to June 15	34	29	25
Maryland							
Baltimore	105	–7	55	Oct. 1 to May 10	44	39	35
Massachusetts							
Boston	104	–14	50	Oct. 1 to June 1	38	33	29
Michigan							
Alpena	101	–27	42	Sept. 10 to June 10	30	24	21
Detroit	104	–24	48	Sept. 20 to June 10	36	30	26
Escanaba	100	–32	41	Sept. 10 to June 15	27	21	17
Grand Rapids	103	–16	48	Sept. 15 to June 1	35	30	26
Lansing	102	–26	47	Sept. 10 to June 1	34	28	24
Marquette	108	–27	41	Sept. 10 to June 10	28	22	18
Saginaw	103	–23	47	Sept. 15 to June 10	33	28	23
Minnesota							
Duluth	99	–41	39	Aug. 20 to July 1	25	19	13
Minneapolis	102	–33	45	Sept. 10 to June 10	30	22	16
Moorhead	110	–48	39	Sept. 5 to June 15	23	14	8
Saint Paul	104	–41	44	Sept. 10 to June 10	29	21	15
Mississippi							
Meridian	104	–6	64	Nov. 1 to Apl. 1	55	51	48
Vicksburg	101	–1	66	Nov. 10 to Apl. 1	57	53	50
Missouri							
Hannibal	108	–25	53	Oct. 1 to May 15	40	34	29
Kansas City	108	–22	55	Oct. 5 to May 15	42	36	31
Saint Louis	107	–22	56	Oct. 10 to May 10	44	38	34
Springfield	106	–29	56	Oct. 10 to May 1	44	39	34
Montana							
Havre	108	–57	42	Sept. 1 to June 15	28	21	16
Helena	103	–42	44	Sept. 15 to June 10	32	27	23
Nebraska							
Lincoln	110	–29	51	Sept. 25 to May 20	37	31	25
Omaha	110	–32	50	Oct. 1 to May 20	36	30	24
Valentine	107	–38	46	Sept. 20 to June 1	32	26	22

(Continued on Data Sheet No. 4-E)

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(Continued from Data Sheet No. 4-D)

(Degrees in Fahrenheit).

State and City	Highest of Record	Lowest of Record	Mean Maximum and Mean Minimum ÷ 2	Period in Which Normal Mean Temp. was 60° or lower Period in	Oct. to April, Inc.	Nov. to March, Inc.	Dec. to Feb., Inc.
Nevada							
Reno	102	–19	50	Sept. 15 to June 1	40	37	34
Winnemucca	104	–28	48	Sept. 15 to June 1	38	34	31
New Hampshire							
Concord	102	–35	46	Sept. 10 to June 10	33	28	23
New Jersey							
Atlantic City	104	–7	52	Oct. 10 to May 5	42	37	34
Trenton	105	–13	52	Oct. 1 to May 20	41	36	32
New Mexico							
Santa Fe	97	–13	49	Sept. 15 to May 20	38	34	31
New York							
Albany	104	–24	48	Sept. 25 to June 10	35	30	25
Binghamton	96	–28	47	Sept. 10 to June 1	35	29	25
Buffalo	95	–14	47	Sept. 20 to May 25	35	30	26
Canton	99	–43	43	Sept. 15 to June 1	29	23	18
Ithaca	102	–22	47	Sept. 15 to June 1	35	30	26
New York City	102	–13	52	Oct. 10 to May 20	40	36	32
Oswego	100	–22	47	Sept. 15 to June 10	34	29	26
Rochester	101	–14	47	Sept. 15 to June 10	35	30	26
Syracuse	100	–22	47	Sept. 15 to June 1	34	29	25
North Carolina							
Ashville	95	–6	54	Oct. 1 to May 10	44	40	37
Raleigh	103	–2	60	Oct. 15 to May 1	50	46	42
Wilmington	103	5	63	Oct. 15 to Apl. 15	54	50	47
North Dakota							
Bismarck	108	–45	40	Sept. 1 to June 15	25	17	11
Williston	107	–49	39	Sept. 1 to June 10	24	16	10
Ohio							
Dayton	108	–28	53	Oct. 1 to June 1	40	35	31
Cincinnati	105	–17	55	Oct. 10 to May 20	43	38	34
Cleveland	100	–17	49	Sept. 20 to June 10	37	32	28
Columbus	104	–20	52	Oct. 1 to June 1	40	35	31
Oklahoma							
Oklahoma City	108	–17	60	Oct. 20 to May 1	48	43	38
Oregon							
Baker City	102	–24	45	Oct. 1 to June 10	34	30	26
Portland	102	–2	53	Nov. 1 to Apr. 1	46	43	41
Pennsylvania							
Erie	96	–16	49	Sept. 20 to June 1	37	32	28
Harrisburg	104	–14	52	Oct. 1 to May 20	39	34	30
Philadelphia	106	–6	54	Oct. 10 to May 15	43	38	34
Pittsburgh	103	–20	53	Oct. 1 to May 10	41	36	32
Reading	105	–14	52	Oct. 5 to May 15	39	34	30
Scranton	102	–15	49	Sept. 20 to June 1	36	31	27

(Concluded on Data Sheet No. 4-F)

TEMPERATURES IN THE UNITED STATES | No. 4-E

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TEMPERATURES IN THE UNITED STATES.

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(Concluded from Data Sheet No. 4-E)

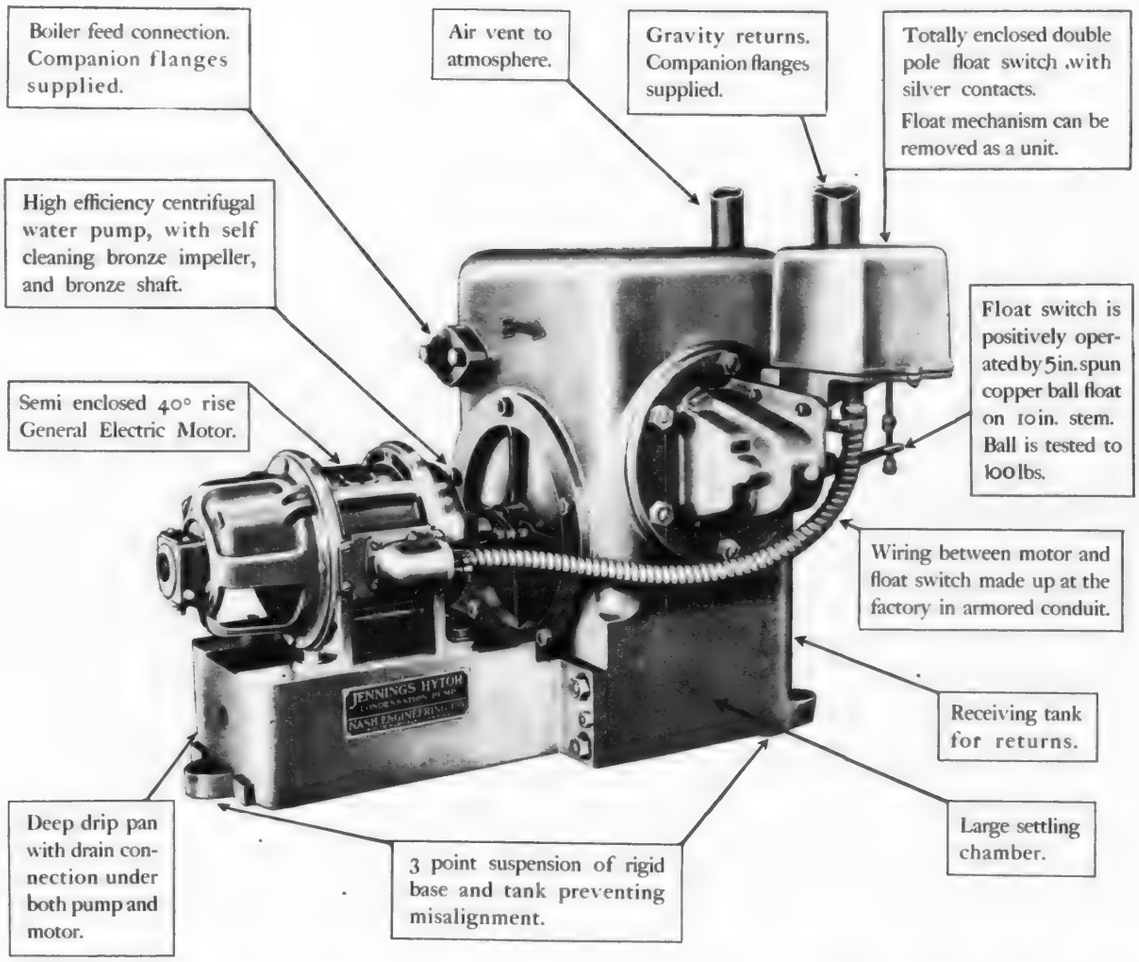
(Degrees in Fahrenheit).

State and City	Highest of Record	Lowest of Record	Mean Maximum and Mean Minimum ÷ 2	Which Normal Mean Temp. was 60° or lower	Oct. to April, Inc.	Nov. to March, Inc.	Dec. to Feb., Inc.
Rhode Island							
Block Island	92	–6	49	Sept. 25 to May 25	40	38	33
Providence	100	–10	50	Sept. 20 to June 1	38	33	29
South Carolina							
Charleston	104	7	66	Nov. 10 to Apl. 1	57	54	51
Columbia	106	–2	63	Oct. 15 to Apl. 20	54	50	47
South Dakota							
Huron	108	–43	44	Sept. 1 to June 10	28	21	15
Rapid City	106	–34	45	Sept. 15 to June 5	32	27	24
Tennessee							
Chattanooga	101	–10	60	Oct. 15 to May 1	51	46	43
Knoxville	100	–16	58	Oct. 1 to May 5	48	44	40
Memphis	104	–9	62	Oct. 20 to Apl. 25	51	47	43
Nashville	104	–13	59	Oct. 15 to May 1	49	44	40
Texas							
Abilene	110	–6	63	Nov. 1 to Apl. 1	53	48	44
Amarillo	106	–11	56	Oct. 10 to May 1	45	41	37
Corpus Christi	100	11	71	Dec. 10 to Mar. 1	66	62	58
Dallas	104	3	65	Nov. 1 to Mar. 20	55	51	47
El Paso	105	–5	63	Oct. 25 to Apl. 15	53	49	46
Galveston	99	8	70	Dec. 10 to Mar. 1	64	59	55
Houston	108	6	69	Nov. 20 to Apl. 1	61	58	54
San Antonio	107	4	67	Nov. 20 to Mar. 5	61	57	54
Utah							
Salt Lake City	102	–20	52	Oct. 1 to June 10	40	35	32
Vermont							
Burlington	100	–28	43	Sept. 10 to May 20	29	24	19
Northfield	98	–41	41	Sept. 10 to May 25	28	22	18
Virginia							
Lynchburg	105	–7	58	Oct. 15 to Apl. 20	47	42	39
Norfolk	105	2	59	Oct. 15 to May 1	49	45	42
Richmond	107	–3	58	Oct. 25 to May 5	47	43	40
Washington							
Seattle	96	3	51	Oct. 25 to May 10	45	43	41
Spokane	104	–30	48	Sept. 15 to June 10	38	33	30
West Virginia							
Parkersburg	106	–27	54	Oct. 1 to May 10	42	37	34
Wisconsin							
La Crosse	104	–43	46	Sept. 20 to June 10	32	25	19
Milwaukee	102	–25	46	Sept. 15 to June 1	33	27	23
Wyoming							
Cheyenne	100	–38	45	Sept. 1 to June 10	34	30	27
Lander	99	–36	42	Sept. 1 to June 10	27	25	20
Sheridan	103	–34	43	Sept. 1 to June 15	31	26	21
Yellowstone Park	96	–41	39	Aug. 20 to July 1	28	23	20

TEMPERATURES IN THE UNITED STATES | No. 4-F

Copies of this Data Sheet, printed separately, 5 cents each.

THE NEW UNIT TYPE JENNINGS HYTOR CONDENSATION PUMPS


Boiler feed connection. Companion flanges supplied.
Air vent to atmosphere.
Gravity returns. Companion flanges supplied.
Totally enclosed double pole float switch with silver contacts.
Float mechanism can be removed as a unit.
High efficiency centrifugal water pump, with self cleaning bronze impeller, and bronze shaft.
Semi enclosed 40° rise General Electric Motor.
Float switch is positively operated by 5 in. spun copper ball float on 10 in. stem. Ball is tested to 100 lbs.
Wiring between motor and float switch made up at the factory in armored conduit.
Receiving tank for returns.
Large settling chamber.
Deep drip pan with drain connection under both pump and motor.
3 point suspension of rigid base and tank preventing misalignment.
JENNINGS HYTOR
NASH ENGINEERING CO.

The illustration shows construction of the Jennings Condensation Pump Unit. By making the pump casing a part of the receiving tank and bolting to the tank the base supporting the motor, allowing the motor bearings to support the bronze impeller, great structural strength is secured. The three point support prevents the pump from being sprung out of line.

Large motor bearings supplied with ample oil wells support the pump impeller and keep it in alignment. Only occasional lubrication is necessary. The impeller is open type, self-cleaning, and very efficient.

The float switch mechanism is liberally proportioned, equipped with bronze shaft supported by two bearings.

The special G. E. double-pole float switch is totally enclosed and provided with silver contacts for long life. Switch mechanism can be removed as a unit.

The finest materials and best workmanship used in construction throughout, and all parts are machined to such close limits that absolute interchangeability is secured.

For Detailed Description, Ask for Bulletin No. 29

NASH ENGINEERING CO.

SO. NORWALK CONN., U. S. A.

NASH ENGINEERING CO., South Norwalk, Conn., U. S. A.
Please send graphic device also bulletins covering
[ ] Hytor Air Compressors
[ ] Hytor Vacuum Pumps
[ ] Return Line Heating Pumps
[ ] Condensation Pumps
Name.....
Company.....
Position.....
Jan

Trade and Miscellaneous Notes

Coming Events

Jan. 22-25, 1924.—Annual meeting of the American Society of Heating and Ventilating Engineers, in New York.

Miscellaneous Notes.

Colonel Oscar H. Fogg, secretary-manager of the American Gas Association, has resigned after a service as head of the gas association since 1919. He leaves to assume the position of president and general manager of the Baltimore Gas Appliance & Mfg. Co., Baltimore, Md. Alexander Forward, of Richmond, Va., a member of the State Corporation Commission of Virginia, will succeed Colonel Fogg. The American Gas Association has a membership of more than 500 manufactured gas facilities in the United States and Canada.

Lafayette, Ind.—The Engineering Extension Service of Purdue University announces the Second Annual Conference of Indiana Foundrymen which will be held at Purdue University, January 17-18. This conference, it is stated, will be of interest to manufacturers using foundry products, as well as to foundrymen. Men of national prominence along foundry lines will lead in the discussion of foundry problems. A similar meeting held last year resulted in the formation of the Indiana Foundrymen's Association and the first annual meeting of this association will be held in connection with this conference.

Heating and Piping Contractors New York State Association held its twenty-ninth annual meeting in Rochester, N. Y., January 8, at the Powers Hotel.

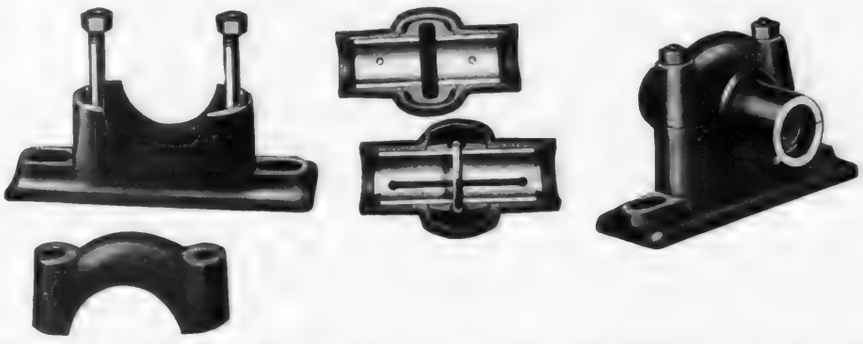
American Engineering Standards Committee, in a bulletin issued recently, attributes the extent to which Germany has so far succeeded in keeping her industrial machine intact, in part at least, to the elaborate scale on which Germany's standardization work is performed. Dr. P. G. Agnew, secretary of the committee, who returned recently from Europe, stated that practically every important manufacturing concern in Germany is officially participating in the standardization program of that country. More than one thousand German companies have formal standardization organizations within their own works, he said, and more than seven hundred national standards have been adopted. Standardization engineering is now a recognized profession in Germany, Dr. Agnew said.

Building Construction in the United States in November increased 19% over the same month last year, but dropped about 12% below the October figure, according to the F. W. Dodge Corporation. Total contracts awarded in November 1923 in 36 States, comprising seven-eighths of the country's total construction volume, amounted to $318,828,000.

Boy Scout Foundation of Greater New York has launched a campaign to recruit 1,000 men to serve as scoutmasters of Boy Scout troops. The campaign will continue from January 15 to the end of the month. Franklin D. Roosevelt is president of the foundation.

New York.—New rules covering the installation of oil-burning devices in dwellings, apartment houses, office buildings and factories, are being considered by the Board of Standards and Appeals. William E. Walsh, chairman of the board, stated the new rules were necessary to minimize the fire hazards in the use of fuel-oil. No action has been taken on the appeal of property owners who have installed devices below the required standard. The only relief that can be obtained, it was pointed out, if any, would have to be given by the Bureau of Fire Prevention. All plans for installation of oil-burning devices must be submitted to the authorities and a permit obtained, it was stated.

AN EXCLUSIVE UNIBLADE FEATURE



SELF-ALIGNING SPHERICAL BALL AND SOCKET TYPE BEARINGS

These bearings play an important part in Uniblade blower efficiency. Lined with a high grade babbitt smoothly fitted to shaft, they automatically maintain their alignment to wear. The flanged ends of these bearings prevent the oil from overflowing from the exceptionally large oil reservoirs.

A duplex oiling system is embodied within all Uniblade bearings, combining both ring and capillary-wick oilers, either of which will distribute sufficient oil to properly lubricate the bearing.

Bulletin 58 explains this and many other noteworthy Uniblade features. Write for it.

AUTOVENT FAN & BLOWER CO.

730-738 W. MONROE STREET - - CHICAGO

Industrial Safety Day in New York State will be observed January 16 as the final feature of the six week's intensive accident prevention campaign conducted under the direction of State Industrial Commissioner Shientag in an effort to cut down the 1,300 industrial fatalities and 300,000 industrial accidents which occuur annually in New York State. Numerous prizes will be distributed for excellence of plans for reducing industrial accidents, submitted during the campaign.

Winter Construction on a large scale is urged by Franklin D. Roosevelt, president of the American Construction Council who states that there is a possibility that the volume of construction in 1924 may equal, if not exceed, that of 1923. With this in mind, Mr. Roosevelt, speaking for the council, urges "all those interested in essential building projects in the near future to undertake such work at as early a date as possible this winter." Otherwise, he warns, spring may find the construction industry confronted with problems of shortage in materials and labor, transportation difficulties and a rising market that will interfere seriously with its progress.

Council of the Institution of Heating and Ventilating Engineers, of England, has offered three prizes for original papers on subjects connected with heating and ventilating. The "Lumby" premium, value ten guineas, will be given for the best paper submitted dealing with heating in the generally accepted sense of the term. The "Sirocco" premium, value ten guineas, will be awarded for the best paper dealing with fan engineering and the general application of fans, air washing, air conditioning, dust and fume removal, etc. The "Preston" premium, value five guineas, will go to the person submitting the second best paper on any subject included in the other two awards. Papers must be submitted to the Institution on or before March 31, 1924 and must be the sole composition of an assistant, that is, one actively connected with the business or profession of heating and ventilating, and is not a principle or an employer.

Central Supply Association will hold its ninety-second regular meeting at the Drake Hotel, Chicago, Ill. February 20 and 21, 1924. The chief business will be definite action on range boiler standardization project, recently approved through a questionnaire.

Chicago, Ill.—At a recent meeting of members of the oil and oil-burning industries, at the Congress Hotel, Chicago, it was voted to appoint a committee to make plans for bringing together the members of these

PRACTICAL AND ECONOMICAL

VENTILATION IS OBTAINABLE AT AN AMAZINGLY LOW FIRST AND MAINTENANCE COST WITH

ILG SELF COOLED MOTOR PROPELLER FANS

THE MOTOR OF THE ILG FAN IS FULLY ENCLOSED AND SELF COOLED—A PATENTED FEATURE.

IT'S PAINTED GREEN —YOU WILL KNOW IT BY THAT COLOR AND SEE THEM EVERYWHERE.

EVERY INDUSTRY HAS ITS SEASONAL PROBLEMS WHICH CAN BE CORRECTED AS SHOWN IN THE ABOVE ILLUSTRATION. THE SYSTEM CONSISTS OF A 36" ILG FAN AND AUTOMATIC SHUTTER WHICH IS EFFECTIVELY VENTILATING THE PRESSING ROOM OF A CLEANING AND DYEING ESTABLISHMENT.

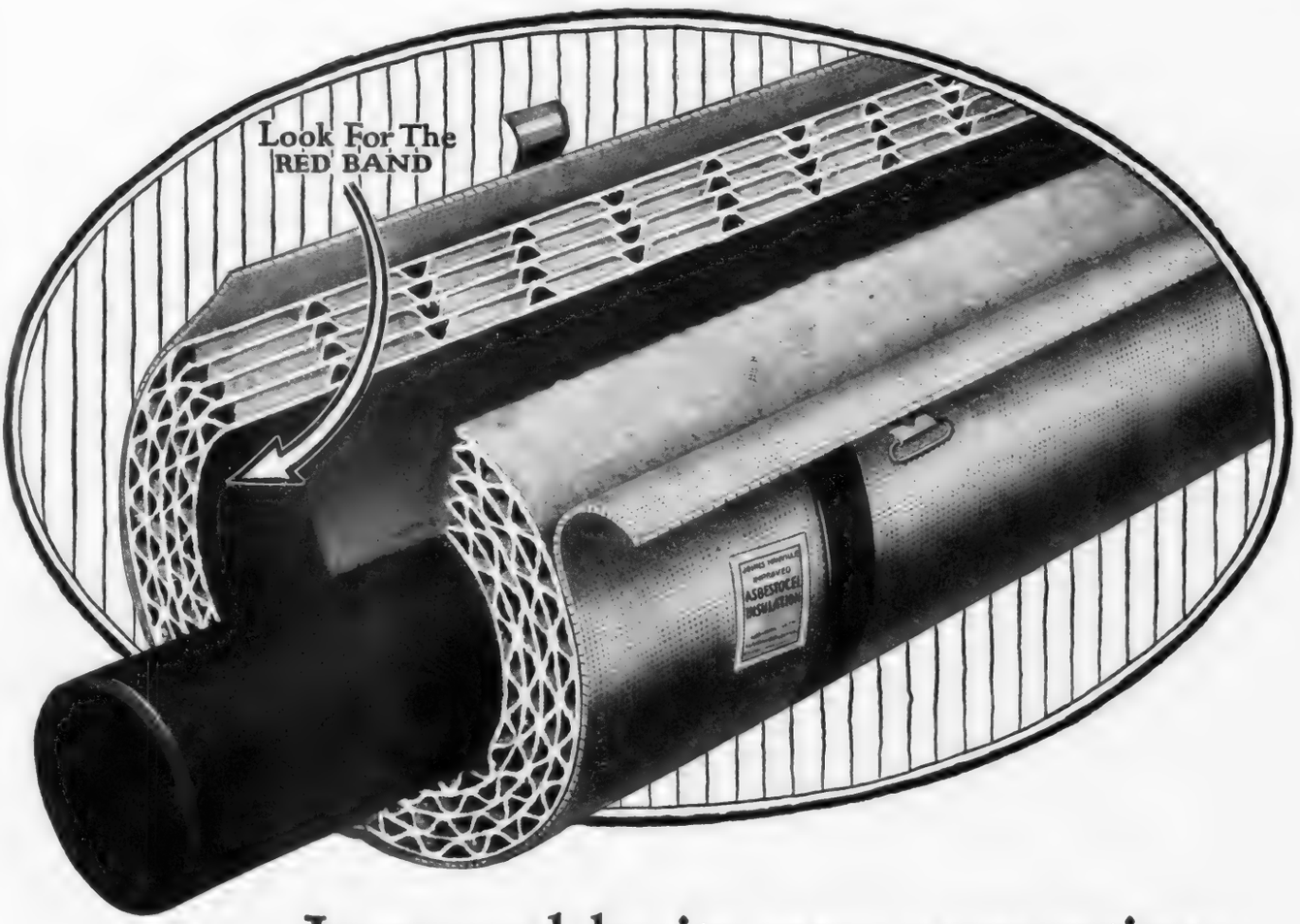
HIGH EFFICIENCY ILG VENTILATING MACHINERY

Ventilation

FOR OFFICES · STORES · FACTORIES · PUBLIC BUILDINGS · RESTAURANTS · THEATRES · HOUSES · ETC ·

ILG ELECTRIC VENTILATING CO. 2858 NORTH CRAWFORD AVE. CHICAGO

BRANCHES IN ALL PRINCIPAL CITIES



Improved by its cross corrugations

CIRCULATING air carries away heat. Air which has an opportunity to circulate freely along the open longitudinal corrugations of ordinary pipe covering, reduces the efficiency of that pipe covering.

Break up these longitudinal corrugations with a series of baffles and the circulation of the air is retarded. The additional cross corrugations in Improved Asbestocel do this, and hence make it more efficient. Observe these cross corrugations in the picture of Improved Asbestocel shown above.

Another thing: pick up a section of Improved Asbestocel and note that the cross corrugations make it stronger. It will stand up much better in service.

We find that we can put these cross corrugations into Improved Asbestocel and still sell it at a moderate price. This makes it the most satisfactory heating pipe insulation you can specify.

JOHNS-MANVILLE Inc.
296 Madison Ave. at 41st St, New York City
Branches in 61 Large Cities
For Canada:
CANADIAN JOHNS-MANVILLE CO., Ltd., Toronto

JOHNS MANVILLE SERVICE
COVERS THE CONTINENT
Through
Asbestos
and its allied products
INSULATION
BRAKE LININGS
ROOFINGS
PACKINGS
CEMENTS
FIRE PREVENTION PRODUCTS

JOHNS-MANVILLE
Improved
Asbestocel

industries. Among those present, who addressed the meeting, were E. P. Bailey, of Philadelphia, representing the American Association of Oil Burner Manufacturers; Charles Baltes, representing the Sinclair Refining Company; and Charles E. Gauer, of the Sterling Refining Company.

Manufacturers' Notes

Chicago Pump Co., Chicago, Ill., has inaugurated a plan of monthly dinner-meetings of members of its sales organization and factory executives at which ideas are exchanged on various ways in which to improve the company's service to its customers. The chief talk of the evening at each gathering is made by a prominent member of the engineering or architectural profession. Recent speakers were Edward P. Rich, Neiler-Rich & Company, and W. C. Bennett, consulting engineer, Chicago.

William R. Basset, president of Miller, Franklin, Basset & Co., Inc., New York, has issued a statement urging manufacturers to use a cost system that offers not only accurate figures on material and labor cost, but takes account also of normals and abnormals, which fluctuate with the activity of business. Usually, Mr. Basset stated, manufacturers shade prices by guess work when lowering prices to get more work into the plant so as to bring operation up to capacity. Such a method, he said, sometimes results in a cut that makes the loss greater than it would be if the plant were shut down.

Westinghouse Electric International Co., New York, has concluded an arrangement with Japanese Electrical interests for the formation of a Japanese electrical manufacturing company to be known as the Mitsubishi Electrical Manufacturing Co. The new company is capitalized at $7,500,000. The American company will profit through the arrangement, an official statement said, by receiving a continuous revenue for service and royalties in lieu of exports which it was certain to lose within a comparatively few years. The Westinghouse company has subscribed to a portion of the stock of the Japanese company. Guy E. Tripp, chairman of the Westinghouse board, and L. A. Osborne, president of the Westinghouse company, both are now in the Orient, having been called there to aid in reconstruction following the recent earthquake and fire.

Scaar-Baumel Co., Rochester Ind., has established a new factory in Rochester for the manufacture of coils for radiators and refrigerating plants.

American Steam Pump Co., Battle Creek, Mich., has purchased the Advance Pump & Compressor Co., also of Battle Creek. The new plant, which adjoins that of the American Steam Pump Co., will be used for the manufacture of duplex pumps. For the present no change is to be made in the personnel or officers of either company.

Wolff Manufacturing Corporation, Chicago, Ill., has completed plans for new financing, the plan providing for the issuance of $2,000,000 7 percent. preferred stock and 150,000 additional shares of no par value common stock. The financing plans were made by Dr. J. T. Duryea, president of Pierce, Butler & Pierce Mfg. Corporation, New York, who has been elected also as head of the Wolff company to succeed Nels Gross. Dr. Duryea and his associates have agreed to take about $1,500,000 of the new preferred stock. Present stockholders will be given an opportunity to buy 100,000 shares of the new common stock, the unsubscribed portion to be taken also by the new interests. There is no connection between the two companies headed by Dr. Duryea.

Hoffman Specialty Co., Waterbury, Conn., has opened offices at 247 McLendon Street, Atlanta, Ga. P. Lee Guest, Jr. is in charge of the new branch.

Richmond Radiator Co., New York, held a conference of its entire sales force at its plant in Norwich, Conn., December 5. The conference was continued December 6 and 7 in New York, at the Old Colony Club. Those in direct charge of the conference were P. H. Seward, vice-president of the company, and A. H. Schroth, general sales manager. Improvements in the company's product and manufacturing facilities were discussed at length, as well as the company's proposed sales campaign for 1924.

Herman Nelson Corporation, Moline, Ill., reports that Univent heaters have been adopted for some of the schools in Japan and Manchuria. Two orders have already been placed and shipments made.

PUBLIC SCHOOL No. 62, BRONX, New York City, N. Y.
Over one Hundred Lehigh Fans are installed in New York City Schools
Engineers—New York Board of Education.
Contractors—Federal Heating Co., New York City

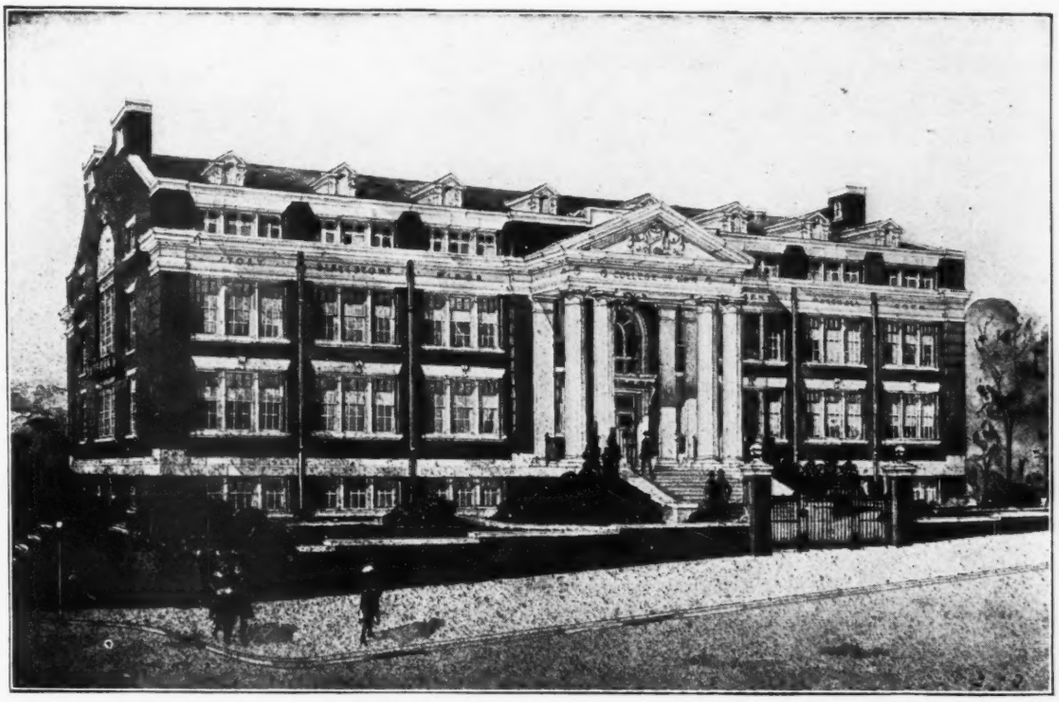
LEHIGH MULTIBLADE FANS

FOR HEATING AND VENTILATING

WHERE large volumes of air are to be handled at comparatively low pressures such as in heating and ventilating systems LEHIGH Multiblade Fans are guaranteed to be equal to, if not superior, to any other fans on the market.

HERSH BROTHERS CO.

654 Mill Street **ALLENTOWN, PA.**



In the Finer Buildings

College of Law, University of West Virginia, Morgantown, W. Va. Architect, Charles W. Bates, Wheeling, W. Va. Heating Contractor, Alex. Zeck and Son, Morgantown, W. Va.

For finer structures such as this, where the best in mechanical equipment is the standard, Heatovent is the logical choice of all ventilating systems. For Heatovent combines perfect mechanical operation with unusual dignity of appearance, simplicity, convenience and serviceability.

Heatovent provides proper ventilation under all conditions through its feature of unit control. Rooms, halls and auditoriums are ventilated independently and at will, a touch of a small button either stopping or starting the measured flow of fresh air of the proper temperature. The simplicity of construction of Heatovent assures long life and service uninterrupted by mechanical troubles. Any contractor can make Heatovent installations without difficulty and at very low labor costs. In addition, this company maintains a corps of engineers always available for consultation with you.

Write our nearest branch office or direct to the factory.

THE BUCKEYE BLOWER COMPANY

COLUMBUS, OHIO

BRANCH SALES AND ENGINEERING OFFICES

Case and Morse, 1018 4th Ave. So. Seattle, Wash.
324 Monadnock Bldg., Chicago, Ill.
216½ N. 21st St., Birmingham, Ala.
503 Wabash Bldg,, Pittsburgh, Pa.
1400 Broadway, New York
Builders' Exchange Bldg., Baltimore, Md.
372 Whitehall St., Atlanta, Ga.

Central Station Heating Notes

Fayette, Mo.—Plans for a central heating plant for Central College at Fayette are being drawn by H. H. Humphreys, heating engineer of St. Louuis, Mo. The plan is expected to cost about $50,000.

Waukegan, Ill.—Discontinuance of the heat service furnished by the Public Service company has resulted in a recommendation to the City Council of Waukegan that between $6,000 and $8,000 be spent for heating systems in the various city buildings. The Public Service Company has announced it will not furnish heat after this year.

Grand Rapids, Mich.—The Consumers Power Co., Grand Rapids, Mich., has spent approximately $850,000 during the past season in expanding its central heating system. Plans for next year call for about the same expenditure.

Houston Tex.—A Central heating plant is to be constructed in connection with the $500,000 training school to be built in Houston by the Sisters of Charity of the Incarnate word.

Hoffman Specialty Co., Waterbury, Conn., manufacturer of the Hoffman line of air valves and other heating specialties, announces that its general sales offices are now located at 512 Fifth Avenue, New York. Charles V. Haynes is vice-president and general sales manager, and George W. Barr, assistant sales manager, with headquarters at the New York office. The company states that during 1923 it enjoyed by far the largest business in its history and arrangements are being made for additional representation among jobbers of heating and plumbing supplies, both in the United States and abroad.

Weil-McLain Co., Chicago, Ill., has appointed J. A. McDonnell as manager of its branch in Fort Dodge, Ia., succeeding J. B. Stewart.

New Firms

R. W. Noland, M. E., formerly professor of heating and ventilation at Purdue University, has opened an office as a consulting negineer at 824 Lafayette Life Building, Lafayette, Ind.

Jahns Supply Co., Fort Worth, Tex., formerly heating and ventilating contractors, have opened a supply house also at 229 West Thirteenth Street, Fort Worth.

New Incorporations.

A. T. Kincaid & Co., 321 E. Monroe Street, Springfield, Ill., capital $25,000, to deal in furnaces and heating appliances. Incorporators: A. T. Kincaid, J. Wernsing and R. C. Walker. Correspondent, W. T. Day, Reisch Bldg., Springfield.

Oilheat Corporation, 39 Milwaukee Avenue West, Detroit, Mich., has been organized to act as distributor for the Oliver Oil Gas Burner Co., St. Louis, Mo. J. W. Keenan heads the new company.

Contracts Awarded.

Industrial Heating & Engineering Co., Milwaukee, Wis., steam heating Riverside pumping station in Milwaukee for $19,295.

J. A. Crook, Los Angeles, Calif. boiler plant for the Huntington Park, Calif. Union High School, for $14,876.

Arthur McKinley Plumbing & Heating Co., Kansas City, Mo., heating and plumbing new Westport Junior High School in Kansas City for $144,889.

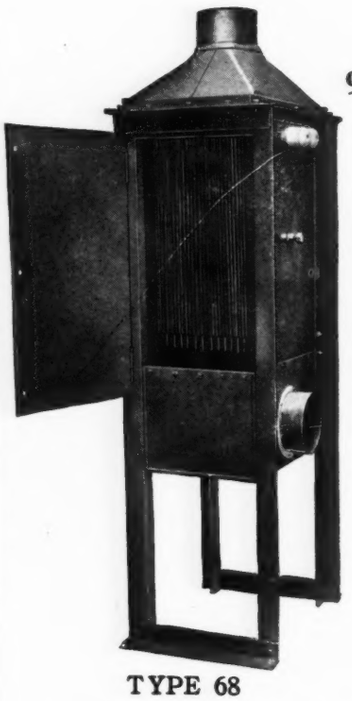
Wages in the Steamfitting Trade

A table of wages in the steamfitting trade has been compiled by the Heating and Piping Contractors' National Association and is published in the *Official Bulletin* of the association for December, 1923. According to this table the prevailing rates in 75 cities are as follows:

	Steamfitters	Steamfitters' Helpers
Akron, Ohio.....	.85	.55
	1.00	
Atlanta, Ga.	1.00	.25
		.40
Baltimore, Md.	1.00	.75
Bayonne, N. J.	1.25	.87½
Boston, Mass.	1.10	.80
Buffalo, N. Y.	1.00	
Canton, Ohio.....	1.00	.75
Chicago, Ill.	1.25	*
Cincinnati, Ohio....	1.05	.78
Cleveland, Ohio.....	1.25	.75

OZONAIR LIMITED

96, VICTORIA STREET, WESTMINSTER, LONDON, S.W 1.



TYPE 68

For large Ventilation and Deodorization Plants.

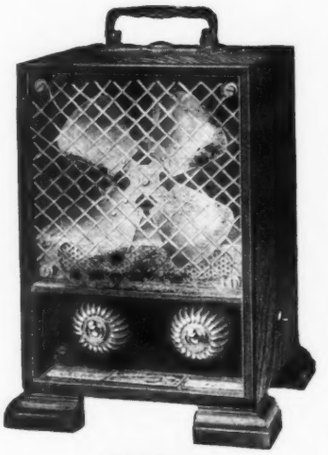
PIONEERS (since 1905) in the manufacture of apparatus for all the technical and commercial applications of OZONE.

Apparatus made under OZONAIR patents and designs give the highest yield of absolutely pure OZONE.

The construction is based on the most simple yet soundest principles so that upkeep is so small, as to be negligible.

The Company are desirous of negotiating with a substantial American Firm for the purpose of arranging sole manufacturing rights.

CORRESPONDENCE IS INVITED



TYPE 32

Portable apparatus for Rooms, Offices, etc.,

IVANHOE MASONIC TEMPLE

KANSAS CITY, MO.

SMITH, REA & LOVITT, ***Architects***
Kansas City, Mo.

MAGILL PLUMBING & HEATING CO., ***Contractors***
Kansas City, Mo.

THIS BUILDING IS VENTILATED

By

SERI-VANE FANS

For heating and ventilating equipment from the simplest to the most complex, write

THE NEW YORK BLOWER COMPANY

2248 S. Halsted Street

CHICAGO, ILLINOIS

Factory: LaPorte, Indiana. **Branch offices in principal cities.**

Our engineers are prepared to give expert advice on cooling, evaporating and conveying systems

WRITE FOR CATALOGS

	Steamfitters	Steamfitters' Helpers
Columbia, S. C.	1.12½	
Columbus, Ohio	1.12½	.37½
Dayton, Ohio	1.15	.35
Denver, Colo.	1.18½	.75
Des Moines, Iowa	1.12½	
	1.25	
Detroit, Mich.	1.12½	
Duluth, Minn.	1.06¼	.45
		.60
East St. Louis, Ill.	1.50	.75
Elizabeth, N. J.	1.25	
El Paso, Texas	1.25	
Flint, Mich.	1.00	
Gary, Ind.	1.50	
Grand Forks, N. D.	.85	.50
Grand Rapids, Mich.	1.00	.50
Haverhill, Mass.	1.05	.45
		.65
Holyoke, Mass.	1.00	.60
Houston, Texas	1.37½	.68¾
Huntington, W. Va.	1.00	.75
Indianapolis, Ind.	1.22½	.65
Knoxville, Tenn.	1.25	.35
		.50
Lancaster, Pa.	.85	.50
Lawrence, Mass.	1.05	.65
Lincoln, Neb.	1.12½	.60
Los Angeles, Cal.	1.12½	.50
		.75
Louisville, Ky.	1.12½	.55
Lowell, Mass.	1.10	.55
Lynn, Mass.	1.12½	.70
Memphis, Tenn.	1.25	.62½
Milwaukee, Mis.	1.00	.62½
Minneapolis, Minn.	1.00	.62½
Montgomery, Ala.	1.00	.25
Nashville, Tenn.	1.00	.50
Newark, N. J.	1.25	.87½
New York, N. Y.	1.25	1.00
Omaha, Neb.	1.12½	
Passaic, N. J.	1.25	.87½
Pawtucket, R. I.	1.00	.65
Philadelphia, Pa.	1.00	.60
Pittsburgh, Pa.	1.25	.80
Portland, Me.	1.00	.65
Providence, R. I.	1.00	.65
Racine, Wis.	1.12½	.56¼
Reading, Pa.	1.12½	.60
Richmond, Va.	.87½	
Rochester, N. Y.	1.05	.24½
		.44½
Saginaw, Mich.	1.00	.50
Sandusky, Ohio	1.00	
San Francisco, Cal.	1.12½	*
Savannah, Ga.	1.00	.50
Sioux City, Iowa	1.00	.60
Somerville, Mass.	1.00	.60
Springfield, Ohio	1.00	
St. Joseph, Mo.	1.25	.60
St. Louis, Mo.	1.50	.87½
Syracuse, N. Y.	1.05	.62½
Terre Haute, Ind.	1.12½	
Toledo, Ohio	1.12½	
Tucson, Ariz.	1.00	
Tulsa, Okla.	1.50	.75
Washington, D. C.	1.06¼	.65
Waterbury, Conn.	.90	.57½
Wichita, Kans.	1.25	.75
Wilkesbarre, Pa.	1.00	
Worcester, Mass.	1.12½	.65
Youngstown, Ohio	1.00	

* Apprentices instead of helpers. Rates dependent upon length of training and ability.

All rates are hourly wages. In some cities, as New York, the rate includes "additional compensation" above the regular rate embodied in the governing agreement.

WANTED

Advertisements under this heading, $2.00 per inch, payable in advance. A 1-in. advertisement contains 35 words. To secure insertion copy must be received not later than the 20th of the month preceding date of issue.

POSITION WANTED—German fellow, university education, wants a position in a contracting concern. Is able to install a system of making business more profitable and getting more contracts by meeting competitors on an intelligent basis. Quality work with guaranteed success. Address, Box 13 care of Heating and Ventilating Magazine.

BOILER MANUFACTURER wants agents. Address Box 124, care of Heating and Ventilating Magazine.

FOR SALE—1 Sturtevant plate fan 100 in. RHTH direct-connected, 5 x 8 Sturtevant engine; 1 Sturtevant plate fan, 140-in. RHTH; 1 propeller wall fan, diam. 49 in., Howard & Morse; 2 No. 5 Serivane multiblade fans, New York Blower Co., RHTH; 2 No. 5 Serivane multiblade fans, LHVU. Eastman Kodack Co., Rochester, N. Y.

WANTED—Position on district heating installation or maintenance by steamfitter, 32, (student) now in contract shop in charge of residence and public building design and installation. Will travel. Speaks French and Spanish, Married. Address, Box 11, care Heating and Ventilating Magazine.

WANTED—Heating Engineers to take over agencies for low-priced domestic oil-burning equipment, made by one of the oldest burner manufacturers in New York. State desired territory and qualifications. Address, Box 12, care Heating and Ventilating Magazine.

POSITION WANTED—I am open to consider a job as manager, engineer, salesman, etc., with any live concern. Prefer to represent such a concern in Cincinnati and vicinity, selling direct to consumer, or will travel in Ohio, Kentucky, Indiana, etc., selling to dealer or consumer. 24 years' experience in heating business. Address Box 10, care of Heating and Ventilating Magazine.

WANTED

Engineer-Salesman by company manufacturing heating apparatus.

Require high grade engineer capable of preparing heating plans and ability to produce business.

Prefer college graduate who has had several years of practical experience in the design and installation of mechanical blast systems of heating schools, factories, etc. salary and commission.

Give full particulars regarding experience, previous connections and references. Address, Box 14 care of Heating and Ventilating Magazine.